

Aviation Week

and Space Technology

October 30, 1961

Welsh Analyzes
U. S. Space
Expenditures

75 Cents

A McGraw-Hill Publication

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solid rocket propellant grains

GIGI is a completely automatic nuclear-electronic detection system, exposing radiographic film for production inspection of the internal sections of solid rocket motors. It is also a powerful research tool for flaw analysis, grain aging, and microcrack/damage studies.

FAST—Inspects Polaris-size motors in 4.5 hours. Film systems take 16.

ECONOMICAL—Requires one or two men only. Film systems use four.

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A custom-engineered GIGI is now available in a range of speeds, derivatives, and costs, adaptable to solid motor production and acceptance inspection.

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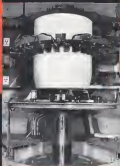
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GIGI

Gamma
Inspection of
Grain
Integrity



GIGI was developed by Aerojet-General Nucleonics to speed Polaris inspection and increase reliability. It checked in half the time required for solid grain inspection.



electronic and cybernetics engineers in a unique role

The engineers and scientists of Aerojet Corporation are in the forefront of a rapidly advancing state-of-the-art in sensing and information systems. Their unique role is critical to the Los Angeles government and the aerospace industry team responsible for development of space systems and advanced ballistic missiles. In this mission Aerojet Corporation provides advanced systems analysis and planning, theoretical and experimental research, initial systems engineering, initial technical direction and general technical supervision. Specific areas of interest include orbital and radio guidance, automatic control, communications, instrumentation, space and ground-based computing, telemetry, tracking, auxiliary power, infrared, television, optics, and photography. Inquiries to assignments exist for those highly skilled in these specialties and who are knowledgeable in inter-disciplinary problem solving. Men with advanced degrees are urged to contact Mr. Harnden, Aerojet Corporation, Room 101, P. O. Box 99341, Los Angeles 45, Calif.

Organized to the public interest and dedicated to providing objective leadership in the advancement and application of space science and technology for the United States Government

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All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.





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MUSKOGEE Oklahoma, U.S.A.

... here's the only large-scale facility for low cost production of borane high-energy fuels

At this modern \$35-million government-owned plant, Callery Chemical Company is carrying out a current Air Force contract to produce 500,000 pounds of Pentaborane. Tonnage shipments of Pentaborane on a regular basis by Callery show the feasibility of producing and handling this energetic fuel in volume. Callery engineers have worked out the handling and safety techniques required for Pentaborane, just as other highly-active materials have been tamed since the Space Age began in earnest.

| Gasifier | Specific impulse (1000 x g-sec) |
|----------|------------------------------------|
| GF2 | 466 |
| F2 | 435 |
| HF2 | 412 |
| HO2 | 405 |
| H2O2 | 381 |
| O2/HF | 390 |
| O2/F2 | 368 |

Take a look at the performance advantages of Pentaborane. The table shows the various specific impulses for some typical space-worthy systems with Pentaborane as the fuel. The data are part of a new booklet, "Propellant Performance Data." Ask for it on your letterhead. Callery's complete technical brochure on Pentaborane is newly revised, too—get your copy by calling or writing:

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Washington, D.C.: 708 40th Street, Suite 100 • Telephone: (202) 440-0000

Dallas, Texas: Suite 12 2800 Park Hills Avenue • Telephone: (214) 343-0000

AEROSPACE CALENDAR

(Continued from page 5)

Nov. 14-16—Northwest Electronics Research and Engineering Meeting, Institute of Radio Engineers, Commonwealth Avenue and Somerset Street, Boston, Mass.

Nov. 15 (7:30-7:00)—Annual Aerospace Engineers Society Display, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 19-22—Symposium on Battlefield Aspects of the Space Sciences, University of California at Los Angeles, Los Angeles, Calif. Sponsors: Ball, Research Institute in U.S.A., Air Force Office of Scientific Research.

Nov. 19-24—Medical and Biological Problems in Space Flight Conference, Natick, Delaware.

Nov. 27-Dec. 1—Aviation Industry Aviation Logistics Symposium, Congress Hotel, St. Louis, Mo.

Nov. 28—10th Meeting, Avionics Division and Manufacturers Assn., Jorg Hall, New Orleans, La.

Nov. 18-Dec. 1—12th National Conference, Institute of Radio Engineers, Professional Group on Vehicular Communications, Radisson Hotel, Minneapolis, Minn.

Dec. 4-5—Booth's Marketing Conference, New York University, Washington Square Center, New York, N.Y.

Dec. 5-11—Annual Meeting, National Air Traffic Conference, Statler-Hilton Hotel, Washington, D.C.

Dec. 5-7—Aerial Convention National Aviation Trades Assn., Statler-Hilton Hotel, Washington, D.C.

Dec. 12-14—Gamma Joint Computer Conference, Statler-Hilton Hotel, Washington, D.C.

Dec. 15-16—Wright Brothers Lecture, National Aeronautics Assn., Statler-Hilton Hotel, Washington, D.C.

Jan. 5-11—English National Symposium on Reliability and Quality Control, Statler-Hilton Hotel, Washington, D.C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior, Washington, D.C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior, Washington, D.C.

Jan. 20-24—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Bayler University, Wichita, Kan.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N.J. Sponsors: Ball, Transfer Dynamics, American Society of Mechanical Engineers.

Feb. 7-9—Third Western Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Conferences, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

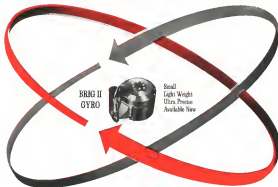
Mar. 18-19—Flight Program Conference, American Rocket Society, U.S. Naval Postgraduate School, Monterey, Calif.

Mar. 26-28—International Conference in Space of Radio Engineers, Columbia University, New York, N.Y.

A PREDICTION

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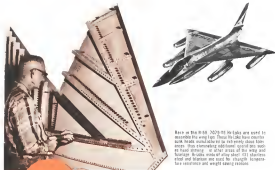
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Back in the 1950s, 1000-10 Hi-Loks are used to assemble the wing tips. These Hi-Loks have counter sunk heads, which allow for extremely close tolerances. They eliminate additional splicing, pins, washers, rivets, or other areas of the wing and fuselage. Results include wing shear (3) stiffness, rived and tapered, we used the change, longer for a consistent and weight saving results.



PROVIDES CONSISTENT PRELOAD IN ALL GRIP CONDITIONS...

The Air Force's Mach 2 B-58 produced by the Convair Division of General Dynamics, packs maximum mission performance and flexibility into a minimum weight and space structure. The Hi-Lok fastener is highly available to this advanced structural design and is used in a variety of conditions.

Used primarily in these applications, the Hi-Lok provides a pre-tensioned clamp-up or ultimate screw nut assembly which is tightly connected with all other Hi-Loks at the same point. Unlike a winged pin fastener, the Hi-Lok returns the stress consistent tensile value in all grip conditions, regardless through moisture.

For open structural areas, Hi-Loks can be installed quickly by one man at rates up to 45 per minute using automatic installation tooling. In congested areas, Hi-Loks can be used without risk of damage to the adjacent structure because Hi-Lok tooling engages the fastener away from the bearing face. Where return flanges restrict access, the Hi-Lok offset 50° and extended tooling provide the necessary reach.

Hi-Lok tooling is simple and inexpensive. It is comprised of adaptor tools fitted to standard, multi-purpose air drivers which may be found in any shop.



BEFORE AFTER

Contact your Representative, Shields Ship VSM, Inc. or Shields Ship VSM, Inc. for additional information on Hi-Loks.

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ASSIGNMENT:

Keep a raging rocket blast from destroying the case that holds it

*How U. S. Rubber makes a
missile fly further by putting
a little salt on its tail*

On the inside is the solid fuel. On the outside is the rocket motor case. And everything in-between is a problem.

Because the burning fuel goes as high as 6000° F, and the case itself can't take much more than 300° F, you've got to insulate one from the other.



A—Combustion B—Transmittal Cooling Film
C—Char Formation D—Vapor Insulator E—Rocket Case
Char alone reduces temperature approximately 1000° F

Yet weight and size are critically important, too. You want to use as little insulator as you possibly can. The less insulator weight, the further the missile will go, or the more payload it will carry. And the thinner the insulator, the more fuel you can pack in. Which again means more distance or payload.

The best insulator yet found is rubber. The rocket blast attacks the rubber to form a layer of char or ash that has a high insulating value. As that char is carried away by the rocket blast, new char is continuously being formed from the remaining rubber. Ideally, the entire insulator is used up at exactly the moment the fuel burns out.

There are ashes . . . and ashes

U. S. Rubber scientists have developed an insulator system that is at least twice as efficient as that previously used. It will enable solid fuel missiles to cut insulator thickness in half. To fly further. To carry more. It should even allow the use of still hotter fuels, if required.

The secret? Salt

Drawing upon its unequalled experience in the development of chemical "blowing" agents for rubber and plastics, USR has incorporated special chemical salts in its insulator compound to produce a simple, yet highly rewarding effect.

As the virgin insulator compound is attacked by the heat of the motor, it is automatically transformed into an open, sponge-like consistency just before it turns to char. The result is a "structured" char or ash with much superior insulating properties.

And that's not all. As gas is formed during this continuous, automatic "blowing" process, it passes through the layer of char to form an additional cooling film between the burning fuel and the char itself. Thus, with the creative application of experience and a known principle, U. S. Rubber has been able to double the effectiveness of rocket motor insulators.

Even at this writing, still further creative approaches to this whole general problem of "sacrificial" insulations are being explored, promising still further achievements in the days ahead. With one of industry's most advanced research and development organizations with broad investigative and productive facilities in chemistry, rubber, textiles, and plastics, U. S. Rubber has had long experience in supplying America's defense establishment.

For information on any U. S. Rubber product, write Product Information Center or call Circle 7-5690.



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**Warns instantly
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If you are concerned with exterior or inside fuel handling, consider these features of General Electric's Automatic Vapor Detector safety device:

IT IS EXTREMELY SENSITIVE. As sensitive as almost as one half part per million of a toxic or explosive vapor can be detected.

IT IS HIGHLY FLEXIBLE. Detector can be easily modified to detect any one of 15 vapors, including hydrocarbons and halogenes, and the list is growing. Many areas can be monitored simultaneously.

WARNING IS ALMOST INSTANTANEOUS. The sampling rate of G.E.'s Vapor Detector is approximately five times a second.

EQUIPMENT IS SIMPLE. Only a pump, sampling unit and alarm unit are required. All functions are fully automatic.

This vapor detector has already been selected by the Navy for a shipborne application, and can be tailored for any application where hazardous or noxious fumes are handled, stored or tested.

Here is another example of LMED leadership in zero-space electronics.

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Prove it...night and day,
wet or dry**

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In full operation is a major addition to the nation's productive capacity for special-purpose vehicles. At Subsidiarily, Condec is assembling major search inventory in its 117,600-square-foot plant. Soon a variety of fuel and water carrying vehicles will roll down the quarter-mile assembly line. No custom bumper production, extra-duty driver when skid-steering, speed equipment handling, and cars are loaded inside at door-level. It's a plant designed for efficiency.

On the 157-acre site, a fully-automated pouring system, including a mile-long belt truck, pours. Condec requires no further design until the last "bug" is shaken out. If you're concerned with purchasing vehicles in quantity for any purpose, Condec can efficiently design and/or build them for you. Contact Mr. James Davis, Vice President, Consolidated Diesel Electric Corporation, Stamford, Conn., Telephone DAvis 5-2121.



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EDITORIAL

Strategy of Terror

It appears that the conflict over the status of West Berlin has now become a miniature battle of will power in which the Soviet Union hopes to force the Western powers into a humiliating withdrawal by a strategy of terror. It is apparently the Soviets' hope that by threatening their nuclear power they can locate the improvements among Western nations that anything, including a Berlin withdrawal, would be preferable to full scale nuclear war. Nikita Khrushchev's advance announcement of Soviet intentions to detonate a 50 megaton bomb has had the effect of convincing the Western powers a "big test" (100 megatons) bomb is clearly part of their strategy of terror aimed at impressing the rest of the world with the leverage the Soviets are capable of inflicting on those who oppose their will. Both the wide variety and the speed of the current Soviet nuclear weapons both come based with the number of recent missile test shots into the Pacific indicate that the Soviets are engaged in a massive and accelerated effort to improve their nuclear weapons strength.

Although the KGB defense claim of Marshal Rodion Malinovsky, Soviet defense chief, has been widely published in daily newspapers, there were many aspects of his speech indicating the size and scope of the accelerated Soviet defense program that were not. For this reason we are devoting a major portion of this space to a dispatch from Ernest Coonan, McGraw-Hill World News correspondent in Moscow, covering these portions of Marshal Malinovsky's speech.

The main points made by the Defense Minister in detail:

• In today's world an armed conflict inevitably will become a total nuclear war if it involves "attack on a nuclear power." The Soviet Union, Malinovsky said, admittedly would suffer great injury, in such a war but is less vulnerable than "Capitalist countries because Russia is great and vast. "We are confident," he said, "that if Imperialism start a war with us the Socialist camp will win and Capitalism will be destroyed for ever."

• In light of the buildup of U. S. nuclear strength, the Soviet Union has been forced to suspend declassification and to increase military spending. Coonan's analysis has been taken to bring the armed forces to combat readiness. Although claiming that Soviet conventional arms are stronger than ever, Malinovsky made clear that the emphasis is on nuclear weapons delivered by rockets. The Soviet defense chief also indicated that "wide area destruction of nuclear arms" began long before the present Berlin crisis. A new kind of armed force has been created, Malinovsky said—strategic rocket nuclear troops which are in constant readiness. They are capable of inflicting a crushing defeat upon an aggressor. He warned that these forces already are equipped with weapons totaling many millions of tons, so if necessary they can deliver more destructive force than was assumed in a study by the Joint Congressional Committee on Atomic Energy. He referred to conclusions that 367 thermonuclear weapons averaging five megatons each

would kill up to 33 million people, devastate 33 large cities and 133 major military objectives, as well as spread radiation over more than half the U. S. territory.

• "Volume of production of rocket armaments during recent years has increased so much as to have a great surplus of different types of rockets." He said that in tests, 90% of the modern types of rockets have achieved excellent or good results while all intermediate rockets launched have achieved excellent or good results. He said that rockets are more accurate over great distances than short ones. "Delegates to the Congress will be informed in detail," he said, "that at present in our military rocket units are about 1,500 subdivisions. They can shoot to any area of the globe without mistake."

• Land units are equipped with tactical nuclear rockets with ranges from several to many hundreds of kilometers, and can be launched on short notice. He described land forces as highly maneuverable and capable of deep penetrations "in conditions of application of nuclear arms in the combat."

• Strong airway capability is shown, said Malinovsky. In the fact that our aircraft, our military transport planes have dropped over 100,000 personnel and equipment, transport of other personnel and freight. He pointed to the additional possibilities of attack by the civil aviation fleet.

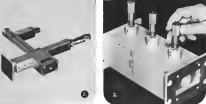
• Special attention has been given to anti-aircraft and anti-rocket defenses. Whereas in World War II an average of 100-200 shots were required to down an enemy plane, one or two anti-aircraft rockets now can down a plane flying at great speed and at altitudes twice as great as the range of conventional anti-aircraft guns, he said.

It was at this point that the Soviet defense chief said the problem of destroying rockets or missiles in flight is successfully solved. He didn't elaborate. Malinovsky said there are about 1,200 subdivisions in the anti-missile forces.

• Poison-gas planes in the air force have been "completely replaced by gas-balloons, gas aircraft including gas-powered long range bombers. Gas cloud aircraft have been replaced by rockets. He claimed that rocketry can give unlimited capability of launching nuclear rockets against "in aggressive from remote distances" are being "more widely introduced." He indicated that such rockets would be launched without entering the defense zone of enemy, anti-aircraft. "The greatly increased battle power of enemy, anti-aircraft," he said, "is being neutralized."

• Submarines are key elements of the fleet, and the basis of a submarine fleet in nuclear ships armed with powerful nuclear nuclear arms, he said. Rocket-armed submarines can be used in conjunction with submarines.

Malinovsky recalled a Khrushchev statement that Soviet submarines can fire ballistic or target-seeking rockets. "Our rocket-armed subs have learned to slip under the Arctic ice and take precise positions for launching of rockets," he said. "This is very important for reliable destruction of objects on land and water. However, he stopped short of claiming that this launch from a submerged position.



TI's RADAR CAPABILITY...



The systems requirements, Texas Instruments now offers major advancements in microwave techniques resulting from 15 years' experience in the development and production of radar equipment. Significant technological advancements include further forward improvement through the following...

1. Broadband parametric amplifiers—typical improvement in radar system noise figures possible with these devices ranges from 4 to 6 db. For comparable gain improvement, using non-reciprocal techniques, it would be necessary to double antenna size or quadruple transmitter power.
2. Pre-selector filters—across-band interference from other radars.
3. Solid-state microwave sources—used as local oscillators or parametric amplifier pump sources—these devices are crystal controlled for high stability and can be used in any application requiring a stable, reliable signal source.



Examples of TI radar systems operational today include the following...

4. Surveillance radars for the U. S. Army Signal Corps AN/SPQ-4 combat radar, produced by Eldec-Rad.
5. AN/APQ-46 reconnaissance radar in the U. S. Army Signal Corps I-BB aircraft.
6. AN/APQ-46 radar and AFA-103A indicator in U. S. Navy F-4F ASW patrol aircraft.
7. Background displays for Nike-Sentinel—the U. S. Army's anti-SCM defense system, produced by Western Electric Company.
8. AFR-4 radar for Federal Aviation Agency controls airport traffic in congested areas. Display reveals precise indication of moving targets.
9. ASR-4 equipment exhibits typical system's design—all components answer for easy servicing.

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WHO'S WHERE

In the Front Office

Dwight Aschaff Co. Inc. Santa Monica, Calif.—has appointed the following division vice presidents: Aschaff-Dominion-W. L. Whitten, deputy general manager; D. M. Mason, commercial sales; E. J. Devlin, engineering and product development; M. J. Kline, general manager; E. L. Johnson, product development; T. J. Dwyer—J. R. Kline, general manager; Charles D. Minkus, vice president of the Santa Monica Co. has been appointed head of the newly established Alaska Electronic Systems and Products Division, Richmond, Va.

Richard M. Wood, a director of Avionics Inc., Arlington, Calif. Mr. Wood is a director and member of the executive committee of Los, Inc.

Bruce T. Clayton, vice president, United Manufacturing Co., Dayton, Ohio, has been Co. President.

Leigh A. Bink, vice president in charge of the Technical Products Division, Pack and Bell Electronics, Los Angeles.

James F. Hadley, vice president, Aeronautical Division of Minneapolis-Honeywell Regulator Co. Mr. Hadley continues as general manager of the division's Electronic Division.

H. G. Conway and R. E. Harp, joint managing directors of Short Brothers & Harland Ltd., Belfast, Ireland.

John F. Jacobs, assistant vice president technical operations, the Mace Corp., San Francisco.

Col. Walter E. Arnold, chief of staff, Technical Command, Langley AFB, Va. Dr. Gen. D. A. Baker, commander, Command for Command, Defense, AFM Co. Lt. Gen. W. H. Blackwell, the assistant general manager, Maj. Gen. W. M. Menden, assistant of operational requirements DGM Operations, USAF.

Honors and Elections

Martin M. Devlin, president of Dallas Corp., has been elected president of the National Aeronautics Assn., according to Jack Casada, new board chairman of NAA. Eugene Fennell, of the Avionics Division of General Motors, succeeds Mr. Devlin as union vice president.

Changes

Richard T. Barlow, assistant engineering manager, Ford & Wherry Aircraft Division of United Aircraft Corp., Los Angeles, has been promoted to chief of the Los Angeles plant. William D. O'Neil, chief of the Los Angeles plant, has been promoted to chief of the Los Angeles plant. Donald J. Jenkins, chief of the Los Angeles plant, has been promoted to chief of the Los Angeles plant.

Dr. Dudley Bern, chief of the Los Angeles plant, has been promoted to chief of the Los Angeles plant. Dr. Dudley Bern, chief of the Los Angeles plant, has been promoted to chief of the Los Angeles plant.

INDUSTRY OBSERVER

Space Task Group reports to complete technical evaluation of the first Apollo spacecraft by this week at Langley, Fort V. Business and economic evaluations will be completed early next month and NASA may award the contract in late November or early December.

Two Lockheed U-2 aircraft have been assigned to the Atlantic Missile Range to obtain infrared homing data during hours of all weather. The aircraft, equipped with infrared sensors, were scheduled to monitor first launch of the Saturn boosters.

Research of large booster using generation of lift in a member cylinder in being studied in the National Aeronautics and Space Administration. Scientists left the facility with a small, cross-section of the lift in a member aligned with the thrust axis perpendicular to the rotation axis. The entire model acts as a lifting surface with a high aspect ratio.

U. S. engineers analyzing photos of the latest Soviet Mi-6 flying over (AW Oct. 9, p. 17) believe the landing gear is new, lighter and better than the earlier system. Purpose of light into work extending from the cockpit to each front gear is nuclear but one theory is that it comes as a hydraulic balancing device. Refers hub design appears to be the same as on the Mi-6 helicopters, but the Mi-6 apparently has followed U. S. practice in shifting to stepped blades to simplify production. Crew's blades now have been a set of earlier tapered Mi-6 blades with a surface added for length.

High-power reactors, with output up to 20,000 megawatts and three levels over 1 million ft. are in the long-way plans of the joint Atomic Energy Commission-NASA Space Nuclear Propulsion Office. This system would be used in a booster stage for propulsion flights.

All electrical propulsion work in NASA is being shifted to Lewis Research Center consolidation work formerly done at Lewis and Marshall Space Flight Center. Dr. Frank Stollinger, who headed the Marshall work in this field, reportedly plans to leave NASA for an industry job. Headquarters management will come under Harold B. Finger, nuclear propulsion director.

First launching of a Titan II, which is to be used as a missile, a Dyna-Soar booster and possibly for the Mi-10 Mercury capsule, now is scheduled for the first quarter of next year—probably in February. First firing had been scheduled before the end of this year.

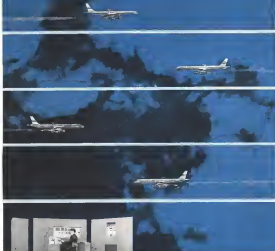
Five brines on Chrysler's C-41 issue will be modified as a result of flight experience gained during the aircraft's Thompson test. The F-41 type brines will be made to deflect through a larger angle from the fuselage to increase effective frontal area and downwash will be reduced slightly, but not enough to require a change in trim.

Borg-Warner's approach to big booster design favors liquid propellants and use of conventional materials as rigid, non-oscillating structure. Composite has experienced with chemically-cured, with aluminum half-rod structure, uses approximately 12 ft. in diameter. Structure could be used for solid propellants. Advantages might include a more even profile with liquid solid supported booster than with liquid in a booster's case. Even a fairly rigid solid structure like Marquardt with more structure of oscillation prevents pressure problems. This feature, plus a possible performance edge with liquids, are Boeing's reasons for favoring the latter propellant.

Second launching pad being built at Pacific Missile Range at a cost of \$270,000 is expected to be ready for use next April. Another pad for space probes, located 1,200 ft. away, is due to be completed the same month. It will handle boosters with thrust up to 150,000 lb.

Poland intends to build a nuclear-powered ship and has begun research of Poland for the engineers who will design, construct and commission the vessel.

ON ORDER from LIBRASCOPE



**CENTRAL DATA PROCESSOR
for AIR TRAFFIC CONTROL**

Today, at a peak traffic hour, approximately 200 aircraft flew over the New York area. Each year this number will increase. Yet, the Federal Aviation Agency will continue to assure safe and efficient control of air traffic. One reason... a data processor developed for the FAA by Librascope to quickly and accurately handle the routine clerical tasks now occupying most of the controller's time. The first 18-unit data processor will be installed at Boston in 1962. A note to Librascope outlining your control problems will bring a prompt answer from the country's most versatile manufacturers of computer control systems.

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Washington Roundup

Mercury Designs

National Aeronautics and Space Administration is studying at least three configurations for advanced Mercury spacecraft, but it will select from only one the design to equip the adapter section with additional engines for a 17-orbit mission.

Another possibility would be expanding the size of the capsule by one-third to accommodate two pilots. That idea is to add six legs to the skirt and six capsules could be maneuvered during reentry. Capsule would be designed to carry two men—rather than one—on a mission up to 14 days. Apollo components would be tested and rendezvous techniques developed with the larger capsule. Other aim would be to test attitude controls and reentry selection procedures for lunar landings.

Some space leaders would rather use an intermediate for the 14-day mission instead of the two men and chaperone originally planned. Questions is whether this can be reduced to point where manned flight is justified.

NASA Education Plan

Pattern for National Aeronautics and Space Administration relationship with universities has now been set. Approach is designed to break down traditional barriers between governmental and university scientists working in the same general field.

NASA Administrator James E. Webb told Aviation Week "a flowering of thought" will result from getting NASA and university scientists, for example, to work on the same problem. NASA space probes and other techniques will gather new information which it is hoped, university professors and their students will apply to space problems in their own laboratories.

First formal attempt to effect this program came last week when NASA announced it had given the Midwest Research Institute in Kansas City, Mo., \$225,000 to stimulate research and industry, without in the space program. Institute will visit scientists and engineers to talk about NASA's program. Next month NASA leaders, as part of the same effort, will meet with California colleges and universities, professors to discuss ways the education can achieve closer ties with the space program.

Contract Studies

Congressional demands for better management of the military contracting program has sent Pentagon officials alert to check how private industry handles similar problems.

Texas Instruments, Austin, Tex., has been selected by the Defense Research and Engineering Division of the Department of Defense, Inc., to study ways to control military acquisition from Gov. Curtis E. LeMay, Air Force Chief of Staff, reduced the bid price because he was impressed by the results of the first stock market made last December at the Martin Co. Denver Division where the Titan rocket is being developed.

Air Force Secretary of Defense John H. Rebel is heading another study to improve both military and industry management of development programs. Robert Taylor, former a project engineer at Hughes Aircraft Co., will be in charge of management within the Office of Defense Research and Engineering. He recently became plans and program director there.

Watch for NASA to establish within its new Aeronautical Research Division (see p. 23) a special branch on civilian aviation.

Rover Publicity

Space Nuclear Propulsion Office has told Rover contractors that its "zero-all policy" in releasing information about the program "is that engineers will be placed in positive accomplishments such as the achievement of milestones" rather than glowing accounts of possibilities.

Donald E. Fraga, manager of the Joint Atomic Energy Commission-NASA office told Aviation Week the Rover program "has a lot of potential but the real question is what we are doing now to get it done." He said "We'll talk about problems as well as successes," but his publicity guidelines were needed to discourage industries from ballooning possibilities rather than their solid achievements.

First detailed estimates of the manpower demand and supply created by the space program will be included in the Collins Commission report (see p. 23) on what costs the U. S. should take in the "space field."

Space agency leaders say the manpower facts will figure heavily in deciding what space projects to undertake. NASA already is planning ways to get industry to make better use of its present aerospace talent.

Significant but largely unnoticed statement leaked deep in recent speech by Deputy Secretary of Defense Roswell L. Gilpin. "Our planners are working on possible military uses of space."
—Washington Staff

Solid Booster to Be Developed for USAF

Golovin Committee approves; \$500-\$600 million project could produce Dyna-Soar, Advent vehicles.

Washington—Defense Department is ready to approve allocation of initial funding for the development of a 128-in dia solid propellant rocket motor for the Air Force (AW July 31, p. 37). The full five-year development program is expected to cost \$500-\$600 million.

This action is expected to be taken following a presentation by USAF Systems Command and Aerospace Corp. to Defense Secretary Robert S. McNamara, Dr. Harold Brown, director of Defense Research and Engineering, and his deputy, John Hubel. Presently, the Lang Research Vehicle Group, known as the Golovin Committee (AW Sept. 4, p. 35), was located on USAF plans and indicated its approval.

The joint Air Force-National Aeronautics and Space Administration Golovin Committee, established to coordinate the efforts of the large launch vehicle program, is scheduled to make its report this week. It is headed by Dr. Nicholas E. Golovin, who has been director of systems engineering at NASA's Office of Advanced Space Flight Program on Nov. 1.

Initial Funding

Initial funding is expected to be about \$77 million. Approximately \$18 million will be allocated for rocket motor development, \$17 million for construction of facilities, and \$15 million for research and development, testing, operations and other basic system costs.

These are preliminary funding estimates in subsequent development: \$195, \$120 million for hardware, \$94 million support; \$194, \$127 million hardware, \$40 million support; \$198, \$130 million hardware, \$23 million support.

Air Force interest in the 128-in dia

ing solid motor with diameter of 136-140 in. for its Nova vehicle. USAF will develop a 30 million lb thrust solid propellant vehicle to NASA specifications under a May 75 contract order.

Solid motor propellant fuel, however, the NASA 128-in dia solid propellant vehicle for Apollo manned lunar landing mission and that the Air Force is an excellent position to strengthen its space role by developing a 20 million lb thrust solid propellant vehicle, better NASA's liquid Nova vehicle is ready (AW Oct. 27, p. 21).

The Air Force 120-in dia motor probably will be developed in development and development configuration. This would be parallel development, but may be performed by the same contractor since the larger design will be a simple extension of the three-segment configuration by adding two additional motor segments.

The larger configuration would have a gross weight of about 450,000 lb, and be 68.65 ft high. Thrust would be 1.4 million lb, and burning time about 120 sec. Specific impulse probably will be 260-265 sec, and the propellant mass fraction is not expected to exceed 0.85. USAF faces dual rejection for thrust vector control.

Development Schedule

Development schedule for the three-segment configuration initially would involve six months. This would be used for preliminary flight readiness testing (PFR), which would start in September, 1968. Main flight test program, involving about 15 months, would begin early in 1969.

Initial development for the five-segment configuration would involve seven months. A six-month PFR program would begin in February, 1969, and a 10-month flight test program would start three months later.

As a guideline to that development program, USAF now is receiving industry proposals for a development of a single segment 170-in dia motor. Air Force is on this competition probably will require a first flight by November, 1967.

Competition for the 120-in rocket, as well as for the solid propellant Nova which USAF is developing to NASA specifications, are Aerojet-General Corp., General Electric Corp., Thiokol Chemical Corp., and United Technologies Corp.

One of the major pricing items in large solid propellant flights will be cost structure of launch facilities. It is expected that USAF and NASA will jointly use the launch facilities to be built for large boosters at the Air Force Missile Range (AW Aug. 25, p. 30).

NASA currently is acquiring an 80,000-acre tract adjoining the Air Force Missile Range on which at least 10 large launch complexes will be constructed.

There will be large launch boosters with thrust up to 12 million lb and the other three are being designed for solid propellant boosters with thrusts to 30 million lb.

USAF may decide to construct other test facilities at the Edwards AFB Rocket Test Site or in an alternative report that NASA vehicle is more recent in the past Ford Test, Mass., state test facility at will require (see last).

Contract Awards

Meanwhile, Aerojet-General Corp. and Rockwell Division of North American Aviation Inc. have been awarded \$500,000 contracts by NASA to study new techniques for building large liquid propellant boosters using at least from 3.14 million lb.

Both companies will study engine development and space booster propellant combinations. It is expected design concept results, the companies will establish design criteria and generate for a large engine. The contracts will run for 10 months.

USAF Fighter Units Moved Back to France

Washington—U. S. Air Force fighter units are moving back into France for the first time since the fall of 1959 as part of the buildup of USAF striking power in Europe in the face of the Berlin crisis and its available capacity space elsewhere because more are crowded than usual.

Presumably, the arrival at the air bases will not be allowed to bring their nuclear weapons stores with them because of a French prohibition that is valid in the pocket of Air Force F-100 fighter units in 1959.

Acceleration of the re-opening of the French bases, five of which have been on embargo status, coincides with the Defense Department order of 11 Air National Guard squadrons to Europe—three equipped with Lockheed F-104s, three with North American F-104s and five with Republic F-4s. The three F-104 units will replace three recently equipped Tactical Air Command squadrons that have been stationed in Europe on a temporary basis for the past several weeks. These will be returned to the U. S.

Reassigned French bases are at Deauville, Chateaufort, Eindhoven and Fribourg. The units have T-28s, B-26s, and are in an open area base for a Douglas B-66 reconnaissance unit.

Air Force and Douglas Accelerate Skybolt Ballistic Missile Program

Washington—Air Force has sharply upgraded the GAM-77A Skybolt autonomous ballistic missile program by expanding missions and contractor staffs and placing responsibilities at higher organizational levels.

These developments followed a year of delays, altered specifications and in decisions as to the needs of the weapon system which is sought to provide a standoff weapons capability for the Boeing B-51H and British Vulcan bombers.

Placement of program direction in the hands of Brig. Gen. David M. Jones, the new commander of the Advanced Systems Division of the Air Force Systems Command at Wright-Patterson AFB, Dayton, Ohio.

Creation of a Skybolt Systems subcommittee of the Douglas Aircraft Co.'s Missile and Space Systems Division at Santa Monica, Calif. Director of the subcommittee is John L. Boring, who is also assistant general manager of the division.

Acceleration in the use of the System Program Office at ASD and shift of a portion of the STD to the Douglas plant.

•Increase in use of the present program at Douglas from 750 to 2,000.

A special program director team from VSCC headquarters at Andrews AFB, Md., now here, is now at the Santa Monica plant supervising the augmentation. In work will be completed early in November.

Launching of the program has been increased by an undetermined amount.

Testing Program

The maximum test program is now planned at four "active" test channels "missiles which will not be fired but will be tested for subsystems, such as "inertial" electronic" which will be used to test the electrical system, and their guided vehicles which will actually be fired.

All missile tests except "dry" tests—normal flights—will be conducted from the Air Force Command Center, Eglin AFB, Fla. But flights will be conducted over the Atlantic Missile Range and controlled down Cape Canaveral after mid-July from Eglin. Test flights due for the first test flight in July, 1962.

Personnel from within the Air Force and from Great Britain were reported



New Skybolt Configuration Fitted to B-52H

Latest USAF Skybolt (GAM-77) configuration recently was fitted to B-52H at Boeing Co.'s Wichita Kan., facility. The unit includes one to be delivered to Edwards AFB, Calif., as performance testing there. Earlier Skybolt was sent, which was a preliminary test, chosen before which was fitted to a more sophisticated configuration. This involves a change from the tip and wing. New configuration is a design system test based on construction of more important sub-systems and some other parts of greater importance, such as, and is known as a sphere-cone configuration.

Mississippi Picked for Saturn, Nova Test Site

Washington—Saturn and Nova state test site will be located on a 15,300-acre tract in southwest Mississippi about 91 mi from the Meridian, La., facility where the large boosters will be built.

The National Aeronautics and Space Administration last week said it will lease the land and obtain construction on 125,000 acres surrounding the test site in a half-year lease. The agency expects to pay \$13.5 million for land acquisition and construction rights.

At least six stands, capable of accommodating boosters from 2.5 million to 20 million lb thrust, will be built at the site during the next three years. Construction will start next spring. The site is accessible via the interstates highway and Paul River for large transportation of boosters from Midland.

The booster site is located in Forest and Shreveport, Miss., and Tennessee, Tenn. La. About 500 homes are located in this area, and the government will allow residents to 30 miles to move, farming, grazing and land use restrictions are contained there, but no homes will be permitted.

About 150 residents are living in the test site tract will be moved by next spring. The site will include 500 to 1,000 homes and will be operated by NASA's Marshall Space Flight Center.

NASA used the Ford River tract was one of 10 sites on the Gulf Coast considered for Saturn and Nova state tests.

NATO Is Hoping to Meet V/STOL Deadline Despite German Demands

The Civil Process

Paris—North Atlantic Treaty Organization officials are still hopeful of concluding the current Dec. 7 deadline for submission of designs, proposals in the NATO V/STOL strike reconnaissance fighter competition despite a new West German bid for modification of the base specifications (AW Oct. 23, p. 21).

"Things are a little bit disrupted right now," an official of the NATO planning section admitted last week. "But I still think we can get it back on track. . . . I'm not unduly worried yet."

Tactical aircraft have to penetrate the German net to push their interceptors that specifications be changed to boost maneuver on the third, performance and incorporate a need for a high-ohmic intercept capability—requirements that might necessitate two separate types of aircraft rather than one.

Germany's own NATO military procurement (EMBK) 3 A variant, EMER 17 calls for an aircraft with the capability of flying at a maximum speed of Mach 32 for a duration of at least 240 m. A covering letter from the NATO secretariat stipulates that any added performance above and beyond that will be taken into consideration.

The aircraft's range, however, has not yet been fully specified, before the secretariat's advice, possibly.

Somehow, if the West German stand and the reasons behind it will be fleshed out in subsequent Euro NATO meetings on several levels—technical, military and political—the mission, they apparently in little outside support for the new plan which would almost certainly bring about a delay in the overall program.

Deadline Problems

If the present deadline can be met, the aircraft section of the NATO secretariat's production and logistics division has a target goal of deciding upon final design for prototype production no later than the following six months.

"We know international cooperation is a time-consuming process, and we are trying to gain as much time as possible," a sector official said.

Although there has been some industry speculation that possibly even this one proposal might be designated for prototype production, primarily because of the national-level political battles for recognition being waged in several quarters, a senior NATO official says that there is little possibility of this within a NATO program. Although he admits there is a strong possibility of some

The same applies to the V/STOL medium-weight transport under JMRB 4 for which proposed design studies must be submitted to NATO through national channels by Nov. 35. Here, however, the initial task is to determine what is available and feasible as well as the requirements of interested member nations rather than a direct move to start intensive production.

Full design reportedly may be awarded for further study and development before one particular aircraft is chosen for actual production by the V/STOL transport NATO leading nations.

Selection of a specific design under BAHR 3 and 4 must first be unanimously approved by both respective working groups, then by the NATO armaments committee and, finally, by the NATO Council. It is hoped that both strike fighters and its supporting transport can be available for operational use by the late 1960s, and at least one competitor such as BAHR 3 aircraft could be ready for squadron service by 1967 if a go-ahead is received by early next year.

Control and Authority

Lines of control and authority have been established along the general lines of those set up for the NATO-sponsored Affaire; isofluprop arabinoside's further research now being coordinated in France, West Germany, Belgium and The Netherlands. France's Biopart, the prime contractor, is in charge of final assembly and final testing.

Once a national delegation was established within the NATO secretariat, they were transmitted to national lines of the member states through national channels, and the series of lines to be connected were supplied by the respective NATO national delegations. Queries for additional information also must be transmitted through the respective national delegations and is used in possible changes of formats, simplified notation, and general rules to national members and national technical secretaries. This will, however, discuss questions of a general nature pertaining to the concept.

During the last of the Atlanta competition, some industry representatives complained that the secretariat withheld the requirements from American firms until it was too late to submit serious bids (AW July 28, 1998, p. 35). Secretariat officials, however, say the delay was due to the fact that the U.S.

delegation actually failed to submit a list of convictions to be returned, apparently, under the assumption that no American firms were interested.

Although it had been under consideration by the military authorities for some time before, the V-STOL strike reconnaissance fighter was first considered by the armaments commission in its summer of 1960, approved and then turned over to a working group for the determination of final specifications. These were made available to the industry in June of the last

When the projects return to the arrangements committee the delegates will be expected to state the quantities of aircraft they respectively intend to order.

In the rush of American firms to gain working agreements for the lighter or transport with European counterparts that are technologically capable and politically potent, some of the late entrants have been hard pressed to find suitable firms that have not been tied down by previous commitments. While such agreements undoubtedly will add a possibly minor note in the political considerations surrounding the very acceptability of a design, a somewhat spokesman said that just that is a minor SSF prerequisite at the present stage.

Centrum produces it, however, and all firms must state their willingness to work with companies in other nations on a partnership basis if free proposals should be chosen. When the competition narrows to two-to-three potential prime contractors, each will be called upon to submit a detailed production program based upon a commitment or requirement, including the names of European partners.

Aerojet Signs Lease For Additional Land

Acropetroleum Corp. has leased from the State of Florida a 25,119 acre tract adjoining the 50,000 acre tract leased from private owners in Idaho.

Under terms of the 10 year lease from the state, Atropel will pay \$81,000 per acre and must begin improvements within a year or forfeit the property. The lease included an option to buy the property, estimated for \$1,500,000.

Script has not announced use to which the land is to be put, but has for some time been selling property on which to build a manufacturing site for large segmented solid boosters (AW Sept. 4, p. 28) and for manufacturing and testing large liquid propellant boost-



Russia Unveils New Mil Turbine-Powered Helicopters

[illegible]

Seaborg Supports Use of Spur For Electrical Space Propulsion

By Kenneth Hawley

Las Vegas—De Glenis T. Seaberg, chairman of the Atomic Energy Commission, told the Symposium on Aerospace Nuclear Propulsion here that the Space System for Nuclear Auxiliary Power (SSNAP) project is an intermediate step toward the development of nuclear-electric propulsion systems and described the USAF Space System Power Unit (SSPU) project as the source of an auxiliary power unit which should make electric propulsion practical in space.

It was the first time that an AEC official has announced the committee's support of the Spar program publicly, and he implied that he will ask for sharply increased funding of the program. After discussing another possible source of the space program, Stokely said:

What must be done in the AEC is a starting point. It appears that the heart of the present technology is incorporated in the Seng series of reactors—which is sodium-potassium cooled and sodium-mercury sodium chloride fueled—now approximately 150 kw of useful electrical output. But there is a need for much more power than 150 kw. Larger energy sources mean the development of a new reactor system; this, in turn means the development of a new technology.

These flame, high power silicon cell systems operating temperatures much higher than are currently being developed. Present systems are limited by a limit of materials which produces a maximum inherent working fluid temperature of 7400°R and it weighs, at best, 55 to 100 lb per kilowatt or more up to 100 hp. Typically, a one-stage watt electric plant based on the limits of materials would have an extremely large radiator. The volume of this radiator would be about 17,000 cu ft. The weight and size of this radiator forces us to look for better systems.

Better welds require higher operating temperatures for the sensor and its components. Higher ambient temperatures of around 1,000 will reduce the size of the component to some thing like 2,000 μm and the cost will be about 10% over 2.5-mil.

Other expanded research can give us the boiling liquid metals, light-weight shielding, more efficient heat transfer, high-temperature nuclear fuel and new structural materials we must have for future high-power, low-specific-weight systems.

The reactor will probably be lithium cooled. The fuel will probably be some form of carbide or some other high temperature fuel material. The reactor as a whole will probably operate in the fast neutron region rather than in the thermal

regions." An AEC specialist commented that this is a rough description of USAF's S&E.

Seiberg also called for accelerated development of nuclear fissionless power systems in the megawatt range. He said the two major problem areas in the development of the systems are the creation of high temperature fuel elements and the development of the base method of thermionic conversion. Reusable thermophores for a fissionless system must approach 1,500° in gel used electron emission characteristics.

Accipit Cancer Nucleosides Division is reported to have proposed to USAF a thionucleic derivative which would serve as a mutagen closer to that of Spontaneous than that of the alkylating agent and transfer base pairs with the thionucleic character grouped around the indazole. Elongation of the Spontaneous occurring and the favorable behavior of the mutagenic induction is expected to be achieved by the use of the thionucleic derivative as a thionucleic which will approximate that needed by the efficient thionucleic polymer composition. A second benefit of this concept is that it would provide an opportunity to study to solve the important problem of mutagen protection against inactivation of the alkylating agent. A single base or an unpaired nucleotide could cause a complete loss of the mutagen while a single base or a pair of bases could cause a complete loss of the mutagen. The alkylating agent is expected to be a thionucleic derivative.

Dr. Senberg said that the policy of the ATC as its space power system or telecommunication program is to seek the largest

power feasible rather than limiting efforts to an arbitrary power level. He said this policy is based on the assumption that the ultimate needs for power will be greater than any known or estimated planning estimates.

Nerva Contracts

Dr. Carl Howard R. Schmidt of the joint AEC-NASA Space Nuclear Propulsion Office told the first session of the symposium that Nerva contracts already include one to formulate a PERT management system for the development, test and refines to prepare test facilities in the big nuclear rocket development center now being established near the Project Rover complex in the AEC Nevada test site.

The first test element of NRDC will be test cell No. 1 in Fort Nemo which is now under construction. It will be the first downwind test stand for a nuclear engine and will have the three bores and some of the other familiar characteristics of chemical rocket test stands. Engines to be tested will be moved from the maintenance, assembly and disassembly building to the test stand by a remotely controlled locomotive using remote handling techniques

already possessed in the Kiva test. When the engine has been coupled and checked out, two halves of a cylindrical shell are moved into place by remote commands to prevent radiation saturation of the test cell structure. After a test the engine will be taken to the MAD building by the remote controlled locomotive. The wind-tunnel studies itself also provides a chamber which is partially evacuated by a strong ejector pump to simulate a high altitude environment.

Three more test stands not yet started will be needed for all the engine, static tests and remote operation tests in the Nerva and RLV (Reusable Launch Test) program. NRDC construction activities are expected to stretch over the next three to five years and are to be on both a large scale and that a construction management company will be chosen for the project.

Schmidt said a stage development contract for the RLV vehicle will be let in early 1962. All of the four contractors who have studied the problem of flight testing RLVs have recommended that the mission profile be a ballistic sub orbit from Cape Canaveral with a Saturn booster.

AEC Plans Launch Vehicle Buy To Study Nuclear Propulsion Hazard

Los Vegas, Nev.—Atomic Energy Commission plans to purchase a one-ton lot of launch vehicles, possibly including the Scout, Pegasus and Thor Agena, for a series of tests to explore health hazards and conditions created by possible failures in launch space about employing nuclear propulsion in nuclear auxiliary power devices, the Atomic Energy Commission's Aerospace Nuclear Propulsion was told here last week.

AEC contemplates a series of experiments possible beginning during the Fiscal 1961 period, to simulate the effects of these nuclear vehicles entering the earth's atmosphere after failure to orbit, or reentry accompanied from orbit or ballistic flight and possibly reentry under control. The commission hopes to gain experience and immediate knowledge from the ground tests in the area before the flight of the first large Scout rocket.

No Obstacles Seen

This was indicated in a report by Lt. Col. J. A. Chandler, Jr., chief, with the division of nuclear development of the AEC, and now with National Aeronautics and Space Administration in Washington.

Chandler says he does not envision any obstacles arising to prevent use of nuclear devices in aerospace environ-

ments. Separately it was reported at the symposium by an engineer from the Martin Co. that the State Department had not received any adverse world reaction to the column in Dallas, Ala. last summer of the first orbital sub-orbit test, a device, a sub-orbit test, made by Martin.

In a related, parallel series of tests to those planned in space vehicles, the Air Force Special Weapons Center has plans developed in now conducting the AEC at the National Rocket Test site in Idaho Falls another series of tests to prepare any health hazards posed by the use of nuclear devices in vehicles that explode on launch pads or in early phases of powered flight, thereby possibly releasing harmful radioactive material. These tests are being conducted with General Dynamics Corp. as a prime contractor. Air Force and AEC hope to learn what happens to nuclear materials released through destruction and fire. They plan to fix some of the test particles may be released, their distribution, etc. In the Idaho Falls experiments, small amounts of fissile materials are buried in crucibles to simulate launch pad destruction.

From the results of these tests, AFSSWC and AEC hope to determine the exclusion zones from the launch

point for nuclear-fueled rockets, the permissible wind characteristics at the time of launch and other factors which can yield in specifying safety conditions for men and equipment. The exclusion zones for nuclear-fueled vehicles may be smaller than that for chemically powered systems.

AEC Wants Control

AEC wants its own launch vehicles so that it can have complete control over its entire payload rather than merely being a payload passenger on another ship as it has been in a recent Atlas E series and on Titan II.

In the projected vehicle tests, AEC intends to simulate the failure of a vehicle to achieve orbit by returning the vehicle into the earth's atmosphere at speeds between 14,000 and 25,000 ft. per sec at shallow reentry angles (about five degrees).

Several such experiments is exploring and hopes to make tests of launch failure risk effects of released materials are:

- Launch
- Detonate capability
- Bleeding up during re-entry
- Return from orbit (burn capability)
- Ultimately, controlled re-entry

In connection with the AEC launch series, the possibility of recovering and reusing the guidance package of a Scout or modified Pegasus missile will be investigated.

Studies Planned

Also mentioned at the symposium were plans for:

- Detailed studies of proton and electron capture, and spectrum to be made by detectors on NASA's A17 and A16 communications satellites scheduled for launch into low-altitude, 40-60, or higher orbits next year. These satellites will be trapped as one-way lifetime vehicles.

- As a SARA satellite shot, scheduled for launch in mid-1962, at the time of the anticipated demise of Explorer XII, for the purpose of continuing its function of measuring fluxes in space.
- Inclusion on Manticore (Atlas Agena B) launch vehicle carrying Venus flyby package) of a plasma probe magnetometer and a device for probing cosmic protons.

• Radioisotope thermoelectric generators using General 342 isotopes as a last source for electric power supply of the Surveyor unmanned, sub-orbital lunar spacecraft. There had been some first short range development and some continuing on the moon, thereby interacting with scientific data designed to yield information about the design of matter General 342 in an Atlas carrier cable and is not expected to interfere with Beta and Gamma rays originating from the moon's surface.

Born to it!

Board fences are hard to find these days. And it's a pity, too. Boys are born to balance on them.

Take the little guy over yonder.

Like all boys, he has a highly sophisticated system of control—one that's outrageously useful on a board fence. He has amazing dexterity to signal just the right muscles, and accurate mechanisms to take just the right action—even if it amounts only to wiggling his feet in his sneakers.

A lot of former walkers of board fences are today looking ahead to new challenges out in a vast region called space.

Some are here with us . . . designing and building control systems for space vehicles.

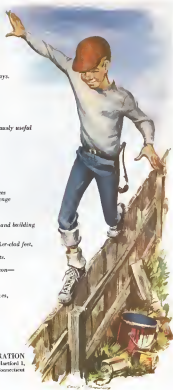
Instead of inspiring witless to sneaker-clad feet, we've got to make control surfaces, nozzles, even entire rocket powerplants. And instead of wiggling toes, we've got to steer space craft by reaction—developing small thrust pulses at their sides.

Just as boys have an affinity for fences, so feel we are born to assignments like these.

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Midas Detects Titan

Cape Canaveral-Volts IV infrared sensor picked up the launch of a Titan KRB1 disintegration flight missile after it was launched here at 6:28 p.m. Oct. 24.

The instrument had 10-min. window in order for Midas to be in sight of the Titan, and the missile was launched during the first minute. Confirmation of the detection was made by the Midas station at Souderton, Calif.

The USAF/Midas Titan reported 6,180 mi. down the Atlantic Meridional Ridge.

Radar Is Seeking West Ford Dipoles

Washington—A radar search area was set up late last week for a small patch of metal filaments believed to have been placed in orbit as a piggy-back payload with the USAF's Midas IV satellite missile defense class system satellite launched from Fort Angeles, Calif.

The controversial Project West Ford experiment, conducted by Lincoln Laboratories for the Air Force Systems Command, is intended to produce a belt of iron dipoles in polar orbit capable of reflecting radio signals at microwave frequencies (3,500 mc.) over intercontinental distances.

Telemetry signals indicated that the 22 x 6 inch cylinders containing 350 million free metal filaments was ejected from its container shortly after the Midas IV went into orbit. If the experiment went according to plan, it was expected to be 30 days before the patch of orbiting dipoles reflected would spread into an earth-orbiting belt.

Difficulty of locating the patch of dipoles may be due to the fact that radar has never before been used to locate an object as target at such extreme ranges.

After about 60 days the dipoles are supposed to be evenly dispersed about the earth at 1,200 ft. intervals with an average density of about 90 dipoles per cubic mile. Air Force spokesmen said their orbital dipoles will be no more than a few feet before the pressure of solar radiation drives them into the atmosphere.

NASA Orders 14 More Deltas From Douglas

Washington—A final contract calling for delivery of 14 additional Delta vehicles has been awarded to Douglas Aircraft Co. by the National Aeronautics and Space Administration. Amount of the contract is \$13 million.

The additional order disclosed in

Aerospace Week in June (Aero 26, p. 12), was due to its reliability demonstrated in the vehicle. Six of the 12 Deltas on the original order have been launched, the last five were successful.

The remaining six vehicles will be used to launch a variety of scientific satellites and two additional Titan weather satellites (Aero Aug. 28, p. 31). The new Deltas will be used to launch Titan and reconnaissance satellites including NASA's Relay and Jupiter and American Telephone and Telegraph Co.'s Teletype active satellites.

The fourth Delta vehicle has been assigned to carry the United Kingdom's electronic satellite designated UK-1 which recently scheduled for a Soviet vehicle, because the satellite is too large to fit the Soviet payload envelope (Aero Oct. 9, p. 27).

Delta vehicles delivered under the new order will develop 150,000 lb. thrust using the MB3-1 Titan booster propulsion system. The first 12 vehicles use the MB3-1 engines strapped to DM-18 Titans which develop 150,000 lb. thrust.

Because of a shorter transition section, the new Delta will be 75 ft. high compared with the 77-ft. vehicles in the first order.

Helicopter Record Claims

An F-4 Phantom II has claimed three new world altitude records for the Kormo 104400 Shaker helicopter powered helicopter. All were made in one flight at the Kormo plant at Woodfield, Calif. They are:

- Fastest climb to 3,000 meters (9,842 ft.) 2 sec. 41.5 sec. Previous record of 3 min. 25.1 sec. was set by a Bell HU-1 in July 1960.
- Fastest climb to 6,000 meters (19,685 ft.) 6 sec. 43.3 sec. Previous record of 5 min. 7.3 sec. set by the OH-6A also in July 1960.
- Fastest climb to 9,000 meters (29,526 ft.) 14 min. 13.5 sec. Previous record was held by a F-4 Phantom II with a load of 17,000 lbs. 43.9 sec. set in June, 1960.

Russian claims recorded by the F-4 Phantom II were also recorded by the Kormo 104400 Shaker helicopter. It was held by the Kormo 104400 Shaker helicopter from those that appeared at the Russian press (Aero Oct. 15, p. 30).

On the 13.21 sec. record the Shaker flew at 360 kph (224 mph) and over the 100 hr. climb course 136 kph (84.6 mph).

The record flight shows that its B-105 fighter set a world speed record over a 100 km. closed course of 1,483.639 mph. would, it appeared, better the old record of 1,390.34 mph. set by Col. John F. Durr in a McDonnell F-4H 1 in Sept., 1960.

Budget Review should be given a larger planning role, the Senate Commerce Subcommittee and not only in its own and final report. The report will the Defense Department's plan to make budget projections for the use of private industry. Data on the situation was the type of information planning would throughout the government.

Liquid-propellant engine rocket was fired from the water at Ft. Meade, Calif., last week, in an experiment designed to determine the feasibility of the technique for liquid engines. Rocket was fired while floating horizontally, balanced upright and fired from under water with about four feet of the top extending above the surface.

Deadline for comments on proposed plan to establish a non-profit company for the development, operation and management of a commercial communications satellite system has been extended from Oct. 30 to Nov. 12 by the Federal Communications Commission (Aero Oct. 23, p. 29). The FCC took the action after request for extension by General Telephone & Electronics Corp.

British European Airways will sell its 21st holding in an independent carrier, Inver Airlines. IFA will first offer the 9,000 shares to holders in Britain, then try to sell them on the open market if the carrier does not purchase them. IFA has been associated with Inver since 1952. Earlier this year, IFA sold its holdings in Alitalia, the Italian airline.

Gen. E. W. Rowlands, former commander of USAF Air Materiel Command, has been named president of General Mills-effective Dec. 1. He will succeed Charles Bell, who will become local chairman of the company. Gen. Rowlands, executive vice president of General Mills since April 1960, is said to have left the Air Force in 1959. He was commander of AMSC from 1951 to retirement.

Boeing B-57D ASW Atlantic made its first flight Oct. 21, at Toulon, France. Flight lasted 42 min. and went off with one difficulty. Two tailfin aircraft powered by Rolls-Royce Trent engines, carried a crew of 12.

Sigurd Varian, 60, founder of Varian Associates, was killed recently when his Piper Apache twin crashed in a heavy fog off the west coast of Mexico.

IATA Plans to Bolster Enforcement Unit

Threat of crackdown by CAB moves convention delegates to seek improved potholing of illegal rates.

By I. L. Day

Sydney, Australia—Fear of governmental interference in the enforcement policies of international airlines has led delegates to the International Air Transport Association's general meeting here to seek to strengthen the *Bribeback* Commission, the group's internal enforcement body.

This action was prompted largely by a letter sent earlier this month to Pan American World Airways President Juan T. Trippe by Civil Aeronautics Board Chairman A.S. Boyd. "The letter, circulated at the opening work session as an agenda item, expressed concern over the 'serious adverse effect of unlawful rate and tariff practices by certain foreign carriers operating to and from the United States.'"

Boyd said he understood that these carriers were becoming more unscrupulous and wanted that to be taken into account in determining a strong enforcement policy was designed to develop proof of such violations. If proved, it is probable that such carriers would receive enforcement steps that termination attempted will be pursued."

Boyd urged IATA to accelerate its efforts to police and enforce agreed rates and concluded that cooperative action would "insure a deterring effect which has not been sufficient heretofore to the flow while creating long-term disadvantages for all."

Chief officer has been the practice of allowing or even encouraging travel

agents to sell international tickets at discounted prices as a means of drawing traffic away from competitors. This has been particularly prevalent in New York, according to delegates.

Cash Under Table

Payment of cash bonuses to sales employees of travel agents is another method allegedly used as a means of luring business. Some carriers are said to be collecting only 75% of the total fare charged the passenger by the travel agent, the one amount of allowing under-the-table discounts.

Generally, it is concluded that violations are committed at the local level and that top-level management are consistently baffling to control them. One carrier, American, considers payment of such cash as reason for immediate dismissal of a guilty employee.

In the past, IATA has taken only lukewarm measures to bolster its enforcement policy. An attempt last year to increase the minimum fine listed on the grounds that, of 891 cases brought before the *Bribeback* Commission, only eight resulted in a maximum penalty. Prior to this week's meeting, a mail vote was taken to amend the rules to determine whether the rules should be changed to hold travel agents rather than airlines directly responsible and thus subject to fines for participating in such cutting. Because of ill effects this proposal may have on airline-travel agent relations it is not expected to pass.

Here are some IATA hopes to adopt at first try: amend strengthening enforcement rules:

- Increase the number of enforcement officers from 24 to 36.
- Use police methods in investigating violations and adopt task force units in investigating industry.

• Authorize fine enforcement of future fines on airlines to authorize. In such cases an airline investigating a passenger from another airline should be authorized to refuse to accept such a ticket if it must absorb an unreasonable discount in the process.

• Member airlines would be required to furnish without detailed investigation to allow more time for handling some situations.

• Although maximum fines would remain at present level, intermediate fines would be increased.

Proposed adoption of the principle that relations are partly out of control because of aggression of British and American carriers.

In general, the fact of this meeting was one of unity, with no real feeling appearing to be more engaged in their own economic problems than in problems of airlines or IATA. Twenty-two airlines members were not represented, including Eastern, Virgin (British), Northwest (British), Trans-Canada (Canada), Eagle (Belgium) and Aeroline Argentina.

Steps taken centered around economic aspects, fares and the fact that, outside of the United States, American, Pan Am, British Overseas Airways Corp., KLM (Royal Dutch Airlines) and Air France. In his plenary Jackson outlined the importance of retaining these larger carriers as top IATA positions because of importance of their routes and weapons capabilities, but called for committee makeup that would cover representation of all major geographic areas.

President of Richard Jackson, president of Seaboard World, who was nominated for a post on the committee by his company, concluded a vigorous campaign during which Jackson represents himself within IATA who want

Equal Fares Sought

Sydney, Australia—International carriers are being a new type of price cutting package from the growing number of newly independent airlines. At the head of the general meeting of Independent Air Transport Association last here has been to prohibit these governments for restrictions regarding the substitution of higher IATA rates levels for the lower fares held under former colonial regimes.

Reform of some airlines to eliminate these has created a problem on several international routes, it was charged, and was also one of the chief reasons for the collapse of the last IATA traffic conference in Geneva, France.

New Overhaul Time Plan Is Devised

Midline-USA airlines and the Federal Aviation Agency agreed to support their own agreement last week on a comprehensive plan for controlling engine overhaul time—plus also of transport EAVY commercial engine overhaul to the airport.

The new program, which aims at an end to past variable, was developed jointly by American, TWA, United and Continental airlines and FAA's Flight Standards Service during meetings that began last last summer. A month's evaluation period will begin within two weeks and involves the fact system that helped monitor the engine along with Fuelburn, Idle and possibly, West Coast Air Lines.

Engineers attending the second Air Transport Association meeting and maintenance conference have agreed that the compromise, which includes significant concessions on FAA part approvals "and repairs." Next month, FAA plan to stop a transfer program to its local offices. It is expected no other agencies on the engine and gas flow system.

Time between overhaul (TBO) of USA airline engines now is controlled by a relatively simple formula that "measures" TBO up and down according to an individual carrier's changing engine failure rate during a 90-day period. For about two years, the airlines have argued that this system is unfair because, they contend, there is no precise relationship between failure rates and overhaul time.

The proposed reform includes a "per mile" or miles between overhaul (MBO) system, which would be based on engine failure rate. This would require more exacting standards on engine failure rates—more the number of engine hours recorded. In the meantime, generally, would be derived separately from the past 15 months of industry experience. Each engine would have a different rate number reflecting the degree of reliability built into it.

stronger representation of smaller carriers as a first step toward breaking current bias toward the large airlines. British Overseas Airways Corp., KLM (Royal Dutch Airlines) and Air France. In his plenary Jackson outlined the importance of retaining these larger carriers as top IATA positions because of importance of their routes and weapons capabilities, but called for committee makeup that would cover representation of all major geographic areas.

American Dominance

Jackson's bid failed to a narrow margin due to lack of American dominance of the executive committee. Although the executive committee members are elected through by electing their own side, Jackson gained his primary goal as the campaign—a more democratic process in the election of committee members through the introduction of a secret ballot for the first time in IATA history.

This achievement gives the liberal group new opportunities to gain more recognition at future meetings.

In a private session before the general meeting opened, the executive committee had considered several means of shoring off a secret ballot, but none was adopted.

On the 100 of each month, all airlines would report to FAA the number of engines they were forced to shut down during the preceding 90 days.

On the 17th of each month, airlines report would explain such decisions, explaining FAA whether it was precautionary or due to a malfunction.

If an airline's submission rate was at or below that of a particular carrier's industry-wide average, that airline would be eligible for a TBO extension meaning it had not been worked one for a specified time limit and it complied with other good rules of the program. Shutdown rates that exceed engine index numbers would fall into what was described as an "alert area."

According to W.F. Diller of ATVA's consumer department to start into disclosure rate would mean an immediate new situation between the agencies and the appropriate FAA regional office, a program to increase the total would mean during days of the engine at once then would be developed in the office and finally analyzed by the FAA. Diller said if at this point the two parties disagreed on what corrective action should be taken, the FAA regional office would appoint a team of experts to study and recommend changes in the program be reported.

Until the reform can make the new system, FAA has agreed to hold in abeyance the proposed Civil Aeronautics Board regulation that would make engine failure rate the sole basis for TBO calculations.

Under the compromise plan, engine failure rates would play an important part in fixing the size of the TBO extension awarded. But FAA also would consider the size of the airline's experience with the particular engine, its maintenance history, its facilities and the reason underlying each shut down it reported.

The daunting prestige of IATA drew some attention, but not enough to make it a factor in the vote.

One suggestion at one point that the general meeting should attempt to devote more attention to guidance of member states and conference parties before the vote was taken.

On the V-B-I, D. DeLongue of KLM who was chairman of last year's traffic conference in Geneva, stated IATA delegates that it would be a long time if it were before he would again accept the task of attempting to

get IATA members to agree or even compromise on an acceptable rate structure.

Work in the general meeting, several attempts were made to persuade DeLongue to modify his report, a cutting criticism of the tactics applied in large meetings in concluding, leading members in discussion on a strategy. The report charged the large carriers with being the most "reticent" blockades of conference time. In acknowledging that discussion on major issues will never be there.

Committee Thought

DeLongue said in his report, is especially written that in "part of the world," he has been needed by the executive board of throwing the industry into an open state of confusion. He deplored the growing use of such a threat to pass a point on traffic conference negotiations and added:

"In some circumstances, positions on the most important issues are being taken and the use of such a threat to pass a point on traffic conference negotiations and added:

Kodak's simple approach to looking and finding

The message is simple: we solicit assignments to make apparatus that finds distant sources of radiance or that points to them with any desired precision.

The message is simple because we do not fear simplicity. Students of current trends in military technology sometimes get the impression that simplicity is best avoided as inimical to the national interest.

What can be simpler than a roll of film? Or more complex and sophisticated than the organization required to make it so that it will perform reliably and well? And there you have the key to our personality, equally applicable to us when making non-photographic infrared scanners or gyro-correcting astro-trackers.

We don't lose interest beyond the breadboard stage, first-class production engineering is our strength. We can also work in harmony as a simple supplier of infrared and visible sensors, optics, and filters to the creative artists of the breadboard, who deserve all the encouragement they can get. There's a living for all.

Our basic portion is infrared components and motivates for simplicity of design led us not long ago to build this piece of hardware. It is an infrared scanning head useful with multi-channel oscillographs for redundancy of faraway worn spots. It also contains an array of gas-discharge lamps that work significantly in correspondence to light shaped by a Schmidt system on a 50 element array of Kodak Ektar Detectors. While the image is resolved across the line of detectors, the line of lamps is effectively swept in synchronism across the visual field of the observer. He sees a picture of a 20' chunk of the infrared emission used for search and track of objects only a few degrees different in temperature from the background.

Another type of Kodak search-track device of an optical nature is ready for breadboarding. This one will be small enough to ride in a space vehicle, along with a computer and an inertial platform. It permits the gyros to be lighter than the demands of precision would otherwise dictate. The computer tells our gadget where to point in the sky to find a certain star. It can cue stars perfectly well in daylight, of course. It looks there, but the directions here and there have been a little erroneous. It then goes center itself on the appointed star and reports an error signal back on the computer. The computer finds this information of great value.

We are afraid that our device to do all this is too complicated to explain here. Not everything can be simple.



PHOTOGRAPHY

OPTICS

ELECTRONICS

MECHANISMS

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If there are any questions, or if you want to set up a discussion on the relationship between your needs and our capabilities in our fields of activity, or for a more copy of a booklet entitled "Kodak's force in being," write Advanced Planning Department,



DELTA JETS link West Coast and Dallas with Cape Canaveral

(ORLANDO)



The only jets between California and Orlando

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THE AIR LINE WITH THE BIG JETS

Four Carriers Accept Labor Peace Findings

Four large carriers last week accepted a presidential commission's recommendations for labor peace, but letter opposition expressed from the flight crew unions raised the possibility of a second major airline strike within a year.

American Airlines, Eastern Air Lines, Pan American World Airways and Trans World Airlines, all of which employ four-class flight crews, formally notified the White House of their acceptance less than two days after release of the Foran Commission's findings (AWT Oct. 24, p. 15).

Along with National Airlines, Western Air Lines and Flying Tiger Line, these carriers were shut down by a working strike at the Flight Engineers International Air last February. The commission was appointed July 10 to investigate the cause of the strike, which arose from the on-going jurisdiction dispute between FELA and the Air Line Pilots Assn.

In fact, four of the commission's report recommended three-man crews on all transport operations, and extensive pilot training for flight engineers on jets.

The flight engineers, with the society and fewer of some 2,700 members at strike, can be equated to airport almost every position of the report. The bulk of FELA's membership on trunk carriers is concentrated at American, Eastern, National, Pan American and Trans World Airlines. The union is fiercer to strike all at once this season, with the cooperation of National, which recently signed a new contract with the union and has been employing a three-man jet crew.

FELA's master executive council last last week to discuss what should the union should make on the report. A strike against Maury, since the Foran jet findings set only recommendations and the basic union is the Delta tradition—personal, quick and exceedingly thoughtful.

Adding to FELA's disapproval of the report is the failure of the commission to force Western Air Lines to reduce flight engineers who worked off during the February strike. Western was the only carrier which refused to do so, ignoring a plea from Secretary of Labor Arthur Goldberg that all parties negotiate a status quo during the commission's study.

The president of the four major carriers, in response to President Kennedy, expressed their appreciation of the commission's efforts to settle the labor issue, which has plagued the airline industry for many years, but made it clear that they are concerned over the cost of flying its recommendations.

Airline Income and Expenses—July, 1961

(IN DOLLARS)

| | Passenger Revenue | F & M | Freight | Flight | Other | Total Operating Revenues | Total Operating Expenses | Net Income Before Taxes |
|-------------------------|-------------------|-----------|-----------|-----------|------------|--------------------------|--------------------------|-------------------------|
| DOMESTIC TRAFFIC | | | | | | | | |
| American | 21,442,700 | 249,824 | 327,412 | 1,748,187 | 28,160 | 24,796,283 | 24,564,483 | -243,379 |
| Eastern | 5,844,948 | 126,134 | 57,861 | 81,247 | | 6,090,190 | 6,040,431 | -49,759 |
| Continental | 5,344,000 | 93,000 | 32,800 | 123,000 | | 5,592,800 | 5,551,000 | 41,800 |
| Cow | 3,121,000 | 307,800 | 200,000 | 450,000 | | 3,878,800 | 3,840,000 | 38,800 |
| Eastern | 19,645,800 | 426,700 | 99,000 | 998,000 | | 20,170,500 | 20,100,800 | -69,700 |
| Norfolk | 6,408,407 | 141,400 | 34,353 | 325,124 | 53,517 | 6,923,241 | 6,954,437 | -31,196 |
| Northwest | 4,775,000 | 81,000 | 32,000 | 74,000 | | 4,962,000 | 4,919,100 | 42,900 |
| Southwest | 6,365,261 | 137,611 | | 429,512 | 4,462 | 6,936,846 | 6,906,104 | 30,742 |
| Trans World | 20,760,000 | 440,000 | | 183,700 | 25,840,000 | 25,840,000 | 25,710,700 | -129,300 |
| United | 40,204,407 | 732,160 | 3,440,327 | 17,477 | 68,117 | 44,715,261 | 44,717,303 | -20,421 |
| Western | 3,254,478 | 99,620 | | 181,133 | 63,453 | 3,495,284 | 3,473,123 | 22,161 |
| INTERNATIONAL | | | | | | | | |
| American | 311,760 | 6,204 | 503 | 47,461 | | 318,928 | 307,326 | 11,602 |
| Eastern | 917,000 | 42,611 | 50,450 | 80,000 | | 1,089,061 | 1,076,104 | 12,957 |
| Continental | 897,043 | 6,893 | 17,842 | 17,842 | 500 | 939,101 | 908,104 | 30,997 |
| Delta | 144,000 | | | 2,000 | | 146,000 | 123,000 | 23,000 |
| Eastern | 3,241,000 | 47,442 | | 136,141 | | 3,384,583 | 3,340,000 | 44,583 |
| Monterey | 162,607 | | 400 | 4,404 | | 167,411 | 158,100 | 9,311 |
| Northwest | 2,437,503 | 638,403 | | 335,717 | | 3,411,623 | 3,370,240 | 41,383 |
| Pan American | 2,417,000 | 2,417,000 | 3,408,000 | 4,408,000 | | 12,650,000 | 12,650,000 | |
| Alaska | 141,000 | 18,000 | | 5,000 | | 164,000 | 164,000 | |
| Admiral | 16,472,000 | 1,117,000 | | 1,435,000 | 3,408,000 | 19,032,000 | 18,824,000 | 2,008,000 |
| Latin America | 9,242,000 | 212,000 | | 11,000 | | 9,465,000 | 9,420,000 | 45,000 |
| Pacific | 9,400,000 | 1,658,000 | | 11,000 | | 11,069,000 | 10,910,000 | 1,559,000 |
| Panama | 1,411,000 | 46,000 | | 245,000 | 8,000 | 1,709,000 | 1,628,000 | 81,000 |
| South Pacific | 83,200 | 260 | | 7,847 | | 83,707 | 79,100 | 4,607 |
| Trans World | 7,748,000 | 440,000 | | 646,000 | 103,447 | 8,937,447 | 8,870,000 | 67,447 |
| United | 5,284,100 | 75,277 | | 81,812 | | 5,441,189 | 5,340,000 | 1,001,189 |
| Western | 234,201 | 2,387 | | 11,473 | | 247,061 | 243,000 | 4,061 |
| SPECIAL SERVICE | | | | | | | | |
| Allegiance | 1,116,704 | 10,277 | 19,276 | 32,327 | 4,322 | 1,178,614 | 1,170,407 | -8,207 |
| Recreation | 447,476 | 3,824 | 1,424 | 5,270 | | 457,994 | 448,671 | 9,323 |
| East-West | 319,300 | 1,167 | 3,613 | 10,000 | | 334,080 | 334,080 | |
| Panama | 826,279 | 16,636 | 4,719 | 27,442 | 3,770 | 878,766 | 870,000 | 8,766 |
| Latin America | 449,070 | 9,048 | 12,141 | 16,683 | | 486,942 | 480,000 | 6,942 |
| Western | 544,364 | 11,814 | 3,613 | 10,000 | | 579,791 | 570,000 | 9,791 |
| South Pacific | 1,137,659 | 10,277 | 19,276 | 32,327 | 3,770 | 1,192,539 | 1,184,000 | 8,539 |
| Trans World | 645,000 | 18,279 | 17,700 | 20,000 | 3,710 | 703,679 | 690,000 | 13,679 |
| United | 844,663 | 1,411 | 3,613 | 10,000 | | 859,687 | 850,000 | 9,687 |
| Panama | 749,203 | 10,277 | 4,719 | 12,441 | 11,154 | 787,794 | 770,000 | 17,794 |
| Latin America | 471,102 | 17,122 | 3,713 | 12,441 | 2,223 | 507,601 | 490,000 | 17,601 |
| South Pacific | 431,337 | 11,842 | 4,719 | 16,146 | 1,863 | 465,867 | 450,000 | 15,867 |
| Western | 571,461 | 9,336 | 1,473 | 15,800 | 1,419 | 599,489 | 580,000 | 19,489 |
| ALASKAN UNIT | | | | | | | | |
| Alaska | 278,497 | 1,706 | | 8,497 | 12,600 | 299,300 | 288,000 | 11,300 |
| Northwest | 507,210 | 27,310 | | 37,310 | 8,770 | 582,600 | 568,000 | 14,600 |
| CARGO UNIT | | | | | | | | |
| Flying Tiger | 6,200 | | | 618,333 | 1,812,000 | 2,436,533 | 2,411,833 | 24,700 |
| Northwest World | 308,300 | | | 10,000 | | 318,300 | 310,000 | 8,300 |
| MICROCITE UNIT | | | | | | | | |
| Chicago Helicopters | 116,384 | 123,816 | | | | 240,200 | 240,200 | |
| Los Angeles Helicopters | 36,401 | 17,104 | | | | 53,505 | 53,505 | |
| New York Airways | 75,333 | 8,347 | 1,960 | 3,149 | | 86,790 | 86,000 | 790 |
| ALASKA UNIT | | | | | | | | |
| Alaska Airlines | 204,139 | 45,200 | 566 | 104,100 | 473,300 | 788,005 | 780,000 | 8,005 |
| Alaska Airlines | 120,820 | 8,442 | | 12,416 | 7,172 | 148,850 | 140,000 | 8,850 |
| Continental | 10,318 | 1,312 | | 6,148 | | 17,778 | 17,000 | 778 |
| Delta | 81,000 | 4,320 | | 3,000 | 1,400 | 90,720 | 88,000 | 2,720 |
| Norfolk | 22,000 | 510 | | 2,600 | | 24,110 | 23,000 | 1,110 |
| Northwest | 140,375 | 30,310 | | 37,100 | 11,100 | 218,885 | 210,000 | 8,885 |
| Panama | 705,408 | 79,726 | 2,420 | 123,270 | 1,064 | 911,888 | 890,000 | 21,888 |
| Trans World | 134,700 | 48,126 | | 47,000 | 36,423 | 266,249 | 250,000 | 16,249 |
| Western Air Lines | 74,401 | 74,349 | | 7,700 | 36,500 | 192,900 | 180,000 | 12,900 |
| Western Air Lines | 317,200 | 37,300 | | 49,700 | 28,260 | 432,460 | 410,000 | 22,460 |

Property

* Non-scheduled transportation

** Not profit or loss

† American Express Company

‡ Delta

Figures for Trans Continental and American were not available

Figures for ALASKA were from airline reports to the Civil Aeronautics Board



727 has 3 rows on each wingtip

Preview of the new short-range Boeing 727



Working on jet engine cabin interior



Jet engine cabin interior



Wide 727 seats provide 6 inches high-density seating



Jet engine cabin interior

Shown above are photos of scale models and a full size mock up illustrating some of the outstanding features of the new Boeing 727 short-range jetliner.

Designed to produce an operating profit even at modest load factors, the 727 is a high-performance jet that will serve 350- to 1,700-mile routes, operating from 5,000 foot runways with full payload.

The 727 brings airline new short-range features, including quick takeoff, rapid climb to cruise altitude, low approach speed, the flexibility required for frequent takeoffs

and landings, and integral airframe stress to help reduce ground time during short stops. Capacity ranges from 39 first-class to 183 tourist-class passengers, plus 850 cubic feet of heated and pressurized cargo space. Another unique 727 advantage is the incorporation of many systems and components proved out in more than 350,000,000 miles of Boeing jetliner operations.

Already, American Airlines, Eastern Air Lines, Lufthansa German Airlines and United Air Lines have ordered 117 Boeing 727s for delivery beginning late in 1963.

BOEING 727

SHORTLINES

► **Allegheny Airlines** reports it carried 74,490 passengers over 15.1 million air-carry miles last month, a 12% increase over the same period last year.

► **American Airlines** reports a net profit of \$1.6 million for the third quarter this year compared with \$4.8 million for the same period last year. Revenues for the same periods respectively were \$109.5 million and \$115.5 million.

► **Dallas to Mexico City** jet service via San Antonio will be started by American Airlines this week with one round-trip daily. Northbound flight will continue to Washington (Baltimore after Dallas). Southbound flight will originate in Chicago.

► **East Airlines** Board is studying passenger rates for foreign and overseas flights. An Transport Service division Board wants to determine whether short-term MATS oil contracts enable higher rates to be earned and if so whether the rate increases should be used for these operations.

► **Federal Aviation Agency** has approved Allison 501 D11 turboprop engines powering Eastern Airlines' and Pacific Southwest Airlines' Electra for 1,000 hr operation between overhauls.

► **International Air Transport Assn.** reports 201,138 passengers and over 2.1 million lb. of freight were carried over the Atlantic by scheduled airlines last month. Passenger load factor was 58.1% last month compared with 63.1% a year ago. Cargo showed an 11.4% increase for September compared with the same period last year.

► **Lockheed Aircraft International** has received a \$770,000 contract from Garuda Indonesian Airlines to provide it with technical assistance.

► **Los Angeles Airways** reports the Pratt & Whitney turbojet engines that power its jet fleet have experienced no flight failure over a 45,000-hour test-to-flight duration as over a 1,000 hours.

► **Texas Western Airlines** has asked Civil Aeronautics Board to approve a new scheduled flight route to become effective Nov. 17. New routes provide a 475 reduction for commodities such as seasonal commodities, cruises and pleasure cruises, and other commodities, including motor, drugs, auto and aircraft parts and similar items would get a 5% reduction.

AIRLINE OBSERVER

► Accident investigators have determined that Federal Aviation Agency's main approach chart for Boston's Logan Airport guarantees the location of the Instrument Landing System Middle Marker is 5.4 mi from the end of the approach ILS runway, but that this marker is actually only 2.7 mi from runway threshold. From now on, there's a chance of a second accident in which an American Airlines Boeing 747 overthrust while landing and tumbled into shallow water off the runway's end.

► **United Air Lines** is using an analog computer to test autopilots. Used as a backup to the manual system pending certification by the Federal Aviation Agency, the computer's computer with 15 main components with seven buses on the manual system. There have been no reports due to computer tests, and prior to its adoption, autopilots were being selected for overhaul about every 600 hours. Standard maintenance procedures called for overhaul every 1,000 hours.

► **Western Airlines** is predicting that shortages of air traffic control facilities are endangering airline operations into Mexico City. One criticism is that the airport lacks an Instrument Landing System, surveillance radar and high altitude approach lights, leaving some pilots to transmit position reports "in the blind" to warn other aircraft of their position. Another complaint is the government's refusal that Mexico's 13,620-sq-ft air traffic control is served by only two VORTAC radar aids (range and 41 non-directional beacons).

► **Widdle Airlines** has attained a daily aircraft utilization rate of 11 hr with its Ansett Whetworth Agass aircraft transports.

► **Airlines** and engine manufacturers are stepping up their competition, and programs aimed at local service airlines. Attendance of manufacturers' representatives at the Las Vegas meeting last week of the Assn. of Local Transport Airlines was more than double that of past meetings.

► **Canadair** Mark 16 jetliners purchased by Trans World Airlines will be equipped with Bendix PB-20 autopilots and dual action 100 light direction and CB-60 gyrocompasses, made by Hughes-Precision Division. Original Canadair, including those purchased by United Air Lines, were equipped with Lear autopilots. Bendix also has sold its PB-10 autopilot for use on the BAC-111 twin-jet transport.

► **Continental** controllers of the Air Line Pilots Assn. will delay its demands for a contract vote on calling a special ALPA directors' meeting to discuss methods of striking the 17-month-old Southern Airways pilot strike (AW Aug. 28, p. 38). Committee members have enough ballots to pass the issue but local union executives taken by ALPA President C. N. Sims and the union's executive committee should be moved first.

► **Local service airlines** are apprehensive about the new network plan devised by Air Cargo Inc. A popular idea with trade carriers, the plan has not been well accepted by scheduled airlines which feel that it might moved into a metropolitan area by trucklines should complete its journey by air.

► **Airline management** have raised questions about the Department of Commerce national transportation policy report scheduled to deliver to the White House this week. In recent speeches, department officials have indicated the report will re-emphasize the need for reform over payments to the government along with recommendations that would drastically reduce federal subsidies, increase competition with airlines, and strengthen airline operations. The report now also explore the airline industry's tax and depreciation policies.

► **Federal Aviation Agency** plans to require the installation of flight recorders on all non-turbine turbine powered aircraft weighing more than 12,500 lb., or certified to operate above 25,000 feet. The change would presently affect F-27 and Viscount corporate aircraft.

Half-mule, half-bird The U.S. Army's Sergeant, now in production, is artillery, and it can traverse terrain where caissons used to go rolling along. And for long, fast hops, the Sergeant can readily be airlifted. The prime contractor, Sperry Utah, wisely selected new, light gages of USS "T-1" Constructional Alloy Steel with 100,000 psi yield strength for the ground support special purpose equipment. USS "T-1" Constructional Alloy Steel is three times stronger than structural carbon steel, thus fabricated components can be made thinner and lighter with no sacrifice in strength. The entire launcher is air-transportable because it weighs only 16,000 pounds—7,000 pounds less than if built with structural

carbon steel. When your missile support system goes on the drawing board, you can obtain applications and development assistance by consulting the one producer of all basic materials for support hardware and facilities. Whether it's carbon steel or special constructional alloy steels, electrical cable or wire rope... consult



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Wide use of USS "T-1" Steel makes the transporter-launcher 7,000 pounds lighter and completely air-transportable.



Prime components of special purpose container (transporter-launcher "T-1" Steel) loaded from a ship. "T-1" Steel, for maximum strength and minimum weight.



424 aluminum-cased USS "T-1" Steel tubing forms the track ring of the launching transporter-launcher.



USS "T-1" Steel tubing legs stabilize the unit in firing position. Also used in "T-1" Steel are the U-bolts, nuts, pins, washers, top and rear bearing members and track wheels.

All major structural components were designed at an allowable working stress of 60,000 psi.

Welsh Analyzes U.S. Space Expenditures

By Edward C. Welsh

To a democracy, as contrasted with a dictatorship, the people not only need to understand the national program of their government in order to perform their responsibilities as free citizens, but they have the right to know. More over, if they do not understand and do not accept the national program, the program will fade on the launching pad.

Consequently, I want to examine briefly some of the questions which, in my judgment, should be answered in this public education effort.

Just how better are the people? It isn't a question of money actually, but rather a question of resources, manpower, skills, materials. However, I phrase the question in terms of money, because those essential resources are the things money will help obtain. In fact, the answer to the question is simple: that the space program is not an either/or proposition.

Of course, there are other very important uses for our money. It is sometimes argued that the funds being allocated to space should better be spent for medicine, schools, housing, research, and full employment. That argument is misleading on several counts. First of all, we could spend a lot more on those worthwhile purposes and still maintain our space program. Second, we did not spend enough money on those worthwhile purposes even before we had a space program, and there is no assurance that sufficient would be spent even if we didn't now have a space program. Third, directly or indirectly every one of those worthwhile purposes will require some of the space money.

It is indeed ironic that we have overcrowded schools, inadequately trained teachers, and obsolete education equipment. Many of these problems are sometimes difficult to obtain because of money prejudices and an outgrowth of protectionism and ignorance.

If it is indeed ironic that we have a number of unemployed persons, will not to work, but unable to find jobs? Monopolistic practices of private corporations and other organizations sometimes contribute to this situation and, I might also add, narrow production opportunities into the future.

It is indeed ironic that sufficient funds are not made available for social care, as well as for child education and better housing. Again, we find

monopoly self interest and selfishness jeopardizing programs in these fields.

In none of these cases is the failure to accomplish due either to our space expenditures or to the lack of resources in this great country. Rather, positive and various forms of self-interest often act to prevent sufficient money from flowing where it would do the country the most good. The fact that this



Dr. Edward C. Welsh

Dr. Edward C. Welsh, member secretary of the National Aeronautics and Space Council, is an astronaut who reached his present position after eight years on the staff of Sen. Stuart Symington for the 1960 presidential election and still director for President Kennedy's Defense Reorganization Committee last year.

Called by Vice President Johnson "the most competent man in government," Dr. Welsh was graduated from Lafayette College in 1950 and earned master and doctorate from Tufts College. He taught at Tufts, the University of Connecticut and Ohio State University. He joined the government in 1951 as an Officer of Price Administration executive, and held positions with economic agencies until he joined Sen. Symington's staff in 1955. He is 52, and a native of New Jersey.

This article is from a speech Dr. Welsh gave at the American Rocket Society's Space Flight Report to the Nation.

a vigorous space program will increase our wealth and our ability to improve our standard of living leads me to another broad question.

•Will the billions of dollars spent on space put a strain on our economy? The answer is definitely in the negative. Of course, space programs will require money and will continue to cost more money, but spending money just to does not stress the economy.

What does put a strain upon the economy is a working economy. While every aspect of the space program may not be handled as efficiently as desired, it is a program of production rather than of waste. It stimulates our scientific knowledge which in turn increases production; it employs personnel and stimulates education; it strengthens progress in medicine, in metallurgy, and in propulsion; it increases and improves various important systems, such as navigation and weather reporting. In brief, the space program will increase both the size of the gross national product and in rate of growth.

•The **space** will the space program cost? Space exploration, space travel, and a wide variety of other space activities will become increasingly characteristic of our way of life. It is impossible to predict costs with any degree of accuracy very far into the future, although we do know what it is costing now, and we have some useful estimates for the costs during the next few years. This year, our scheduled space efforts will cost between \$3.5 and \$3.7 billion. This total will increase over the coming years so that it may average about \$5 billion a year over a five-year period. To help place these figures in perspective, I would like to show that some half-decade before the people of the United States will average about \$35 billion per year for healthcare alone. This amounts a 5 to 1 ratio of costs to the expenditures over space expenditures.

Production Stimulus

Put in another way, it is estimated that during the coming five years as we, as total space expenditures—not just the money spent for exploration of the space—but will average approximately 10% of our gross national product. While doubting that actively self-perpetuating of our own product, it will at the same time be stimulating a substantial rate of increase in the country's production of goods and services.

I do not want to leave the impression

that the cost will be negligible. The contrary is true. The space program will become more and more expensive. It could amount over the next five years to an average per capita cost of \$155, i.e., \$35 per year of 10 years per week. That is a much estimate, which might be at a little in either direction. In any event, it is not unreasonable to assume that during the next five years the average amount in the U.S. will increase from \$35 to \$155 per year. If it does, the cost of the space program to the individual can be easily absorbed.

Since the most expensive and most hazardous aspect of our current space effort is the manned second trip to the moon, another appropriate question occurs.

•Is the lunar trip necessary? The answer is "yes." Let me say, however, that it is not just to give an educated answer to a question about something which has never been accomplished.

I have heard a number of seriously expressed objections of agencies on the subject of space. I will cite two examples: the first of which is that we have landed some times before "We go to the moon? Why don't we stay here and watch our television sets like God intended us to?" A reasonable statement, made with sincere intentions as in a public meeting for a man of high public office. He asked "Why spend our money to go flying around in space? If there are people up there in Mars, let them spend their own money and come down here and show themselves to us."

These examples reflect the thinking of the type of people who considered the moon's energy, the surgeon's scalpel and airline planning at the end of the world. If they had been wise, the wheel would have been made with steel-headed chisels as soon as it was invented. Incidentally, you may have heard or read that some scientists are opposed to a manned program. There may be a few who take that position, and more but a few. Why? Well, this was done in an attempting thought to show, but scientists are people and like the same as the rest of us. Scientifically, however, some scientists are afraid that so much of the money involved will go for the production of hardware that not much will be left to go for scientific research, and research organizations for discovery and careful scientific study. They do not challenge the need for space exploration. They are for that. However, they want to see scientific equipment and research organizations for discovery and careful scientific study. They do not challenge the need for space exploration. They are for that. However, they want to see scientific equipment and research organizations for discovery and careful scientific study. They do not challenge the need for space exploration. They are for that. However, they want to see scientific equipment and research organizations for discovery and careful scientific study.

The advantages of uses in space vehicles seem to me to be obvious. There are observations, reconnaissance, actions,

and sometimes covering which can be made by men and cannot be made by instruments alone. These facts are equally applicable, in my judgment, whether the spacecraft is as small as a man's car or as large as a man's car.

Let us take the moon? The fact is that there is no other place to see in space where we can find the equipment and the men for the space travel. The moon is a tangible objective as a near space program and our political programs are largely in that direction, which the activity is good. For a moon trip we need the following: powerful rockets, sophisticated spacecraft, trained and carefully selected astronauts, and a protection against the multiple hazards of space travel. There are requirements for all anti-space exploration and the moon program's own challenges in development. Moreover, we can be certain that our nation which can successfully master this objective can do so on other things which can threaten or protect the world's security and which can contribute to the peaceful development of our world.

•How does the U.S. compare with the USSR in the space race? Of course, we know, with more resources than the U.S. has accomplished than what has

been accomplished by the USSR and what new information they have obtained. However, based upon such data as is readily available, the following would seem to be a reasonable expected comparison. The U.S. is first in the number of successful launches by a margin of more than 3 to 1. We also have obtained a wider range of scientific information about space and have made more progress in applying space technology in the civilian, military, and communications fields. We can speak less positively about comparative progress in guidance and systems reliability.

It is clear, however, that the Soviets are ahead in the single most critical aspect of the race, the ability to put heavy payloads into space.

While we are making an effort to overcome this "bottleneck," we must assume that the Soviets are not waiting for us to catch up.

Inventory Needed

In order to meet the space challenge, we should take an inventory to determine what we need in resources and what we can do to supply these needs in quantity and probably in sufficient quality. This raises the question

•Are we really deficient in the resources necessary to attain space leadership?

As to this, there is no simple answer. It is not correct to assume the answer would be a quality answer. The process of increasing this supply is slow and long, so must accompany our efforts

to meet the space challenge.

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Saturn Stages Transported to Cape Canaveral

Overhead shot and shown several days of Saturn stages, about the Saturn stages Cape Canaveral, just through a lock on the Transverse Road along top from Huntsville, Ala., to Cape Canaveral. Vehicle on the large S-61 first Saturn research and development rocket, which is due to be launched soon. Large nose section is in wheel to move of transportation after another look at the nose collapse, requiring large large systems.

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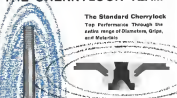
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The Cherrylock "2000" series team offers the finest, most adaptable and efficient yet developed. Maximum joint strength and reliability are obtained by using the Standard Cherrylock to cover the entire range of applications. The Bolted Cherrylock for stem grips and double clamps, the Standard Cherrylock in the longer grip. Both types are finished with the same H-448 series polishing head, using existing Cherry gear.

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head efforts with a vigorous program aimed at offering better use of the small number of able and well-trained people available. This applies not only to scientists and engineers, but also to a wide range of other competencies as well. The geriatric emphasis placed upon training in the sciences, the sciences and in engineering should not, for example, include equally great emphasis upon administrative talent. The demands for professional skill in management are great. It becomes gratifying because the needs will become more complex and the problems of coordination and integration of efforts more difficult. We are, in fact, moving from a period characterized by somewhat isolated experiments in an era of comparatively complicated operations in which many elements had to be put together properly if success is to be obtained.

Your government, wherein the major responsibilities for the space program in engineering, construction, flight, is obtaining competent technical and management personnel. The intangible needs for assisting the government in the great areas are for growth, more than anything else, for the sales opportunities provided by private industry. I might add that it is even necessary the taxpayer pays the other, other, death, if so the government growth or industry is a part of the cost of a contract with private industry.

Low-Quality Hardware

On the other hand, the big challenge to industry is not so much that of obtaining capable individuals of high quality, but rather a need to establish much higher standards of quality in the space hardware it sells to the government. Our space activities are far more technically demanding than low quality products from private contractors.

The fields of technology and business management are becoming, not the main area in which there is a large need for more highly trained specialists. The demand also dips into the social sciences. For example, economists and fiscal experts are needed to help plan the contribution of our resources so as to maintain, guide and to limit the growth of our national space effort. Social scientists and lawyers are needed to develop the necessary legislative framework, space law and solutions for a new crisis of international relations. Sociologists and psychologists will be concerned with personnel training, motivation, and the growth of new competencies associated with expansion of the space horizon. Language specialists will also have an important role. There will be an enormous task of communicating the meaning of space to the public, writing the technical manuals and perhaps even some data of developing means for communication



Re-entry Nose Cap

Since advanced space nose caps, using the thermal ablative process, has been developed by Area Corp. for missiles tested on the Scout rocket solid propellant vehicle. Re-entry instruments will be mounted by 26 thermopiles inside the

with forms of life on other planets. I believe it is a fact that few students and few controls will be developed in the growing demands of the space age.

As we proceed to expand our ideas, we must also take giant steps toward improving the economy of the industrial knowledge, new discovery, and improved engineering practices. A central clearing house for such information is definitely needed. Technical organizations like the American Rocket Society can coordinate significantly in this whole educational process.

In brief, the answer to the question is to whether we are deficient in resources is not too demanding. Of course, we have shortages, and they will become even greater. However, if a positive national program is coupled with a vigorous national effort, we need not feel that manpower shortages will be the primary cause of failure. Rather, extraordinary failures are most likely to come from insufficient effort in providing the resources we have available.

I might like to mention that the hard work on this education problem, in solving some of the things accomplished this year in the space program.

The following is a partial list:

(1) The Space Council has been established to give the President coordinated policy recommendations on all aspects of the space program. (2) Basic decisions have been made to accelerate our space efforts, including the setting of specific space objectives and at several basic categories: global communication, satellite systems and global weather satellite systems. (3) Large rocket engine programs—liquid, solid and nuclear—

have been speeded up. (4) Funds for this overall research have been requested and obtained from the Congress. (5) Improved procedures have been established for coordinated action on the part of the several government operating agencies engaged in the space program. (6) Actions have been taken to strengthen the organization and administrative structure of the space program within the government, including increasing and reorganizing personnel strength. (7) A national policy has been issued for the communication satellite system. (8) More successful space shuttle have been made and more reliable space information and experience have been obtained than in any comparable period.

In conclusion, I suggest two broad generalizations. First, the space program will give the greatest impetus to education since the development of mankind, in the past, and second, the more fully the government is kept informed and understands the significance of space exploration and space development, the more successful our one of efforts to toward world leadership in the space field.

We must turn the space race into a race to become a second-rate nation in technology, in science, and in world influence. Most important still, the focus of this race must be toward developing a second-rate economy.

Nuclear Detection In Space Under Study

Bethel, Mass.—Study contract to develop ground-based optical techniques for detecting nuclear explosions in space through observation of the light has been awarded to General Corp. of America Inc. by USAF's Aeronautical Systems Division.

Dr. Edward B. Manning, project manager of General's optical program, and photometric equipment can be developed to assist from earth-based nuclear explosion detection elements at great distance in space by studying sunlight scattering.

The line of research under development is expected to be based on laser light in space. Dr. Manning added, and in preparing theoretical techniques of probable spectral characteristics of such light as explosion.

Equipment developed under the project will be based on laser principles to analyze and detect phenomena, he said.

The contract, third awarded to General by the Defense Department, is part of the Defense Department's Project Vela studies to develop effective and reliable techniques for use in international control of a possible nuclear test ban treaty.

Barber-Colman temperature controls chosen by leading makers of ground support equipment



Today's air and space vehicles will be growing array of ground support equipment. Shown above are a few examples of support units employing Barber-Colman temperature control systems. Components used include: control boxes, actuators, valves, interconnects, sensing elements, and thermostats. The systems are specifically engineered for each application through the teamwork of the ground unit manufacturer and Barber-Colman.

Barber-Colman temperature control systems. Components used include: control boxes, actuators, valves, interconnects, sensing elements, and thermostats. The systems are specifically engineered for each application through the teamwork of the ground unit manufacturer and Barber-Colman.

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Engines with thrust ratings of up to 100,000 lb. are tested here solely on the Edwards AFB test stand for Air Force Systems Command.

Edwards' Rocket Facility Checks Out Components

Edwards' Rocket Facility latest cell, used to check out engine injection and propellant modification, has two test chambers—two rated at 30,000-lb. thrust, and the other two at 40,000-lb. thrust. Simple Aztec tanks are used as observation points. Dynamic and static tests are made in vibrant, regulated, gaseous conditions, and other rocket engine subassemblies at the Rocket Facility's component testing station. Test stand at the facility is used to test new propellant combinations, thrust chamber design and engine components.



Models up to 330,000 lb. are simulated in this vacuum chamber at the Edwards AFB Rocket Facility. Chambers are used to test low thrust, lightweight rockets.



Component test facility at the Edwards' Rocket Facility contains a series of cells and chambers through which gases and fluids are pumped to simulate flight environments (top). Rocket engine systems and propellant combinations are tested in low cost cell (below).





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AERONAUTICAL ENGINEERING

GE Sees Variety of Uses for T64 Engine

By David H. Hollman

Low, Mass.—General Electric is predicting that its T64 turbine engine—conceptually alone in the 2,500 to 3,500 shp power class—will play a leading role in powering the larger V/STOL aircraft scheduled to appear during the next decade.

First headed by Navy in 1957, the T64 joined three significant successors last month as it was selected to power the Ling-Temco-Vought, Holzer, Ryan in service, V/STOL transport; it now flight-

tested for the first time on a de Havilland Canada jet and it completed a formal, 190-hr qualification test using JP-4 fuel.

In developing the T64, GE took the best design and components it had on hand and combined them into one powerplant. The engine itself, however, breaks no fresh ground in technology, nor does it offer a power-to-weight ratio equal to that of the GE T58.

Although its specific fuel consumption of about 0.495 at sea level is con-

sidered a strong point by GE, the engine's turbine inlet temperature of about 2,700°F, its compressor pressure ratio of 12.6 to 1 and its best power-to-weight ratio of about 8 shp/lb have been surpassed by other production engines.

Nevertheless, GE believes these numbers describe a balanced engine that satisfies a variety of performance requirements while meeting design goals of simplicity, maintainability and low life-cycle cost.

Compositional Engines

The power class occupied by the T64 is handled on the high side by General Motors-Allyson T56 series engines which develop 1,750 to 4,950 shp and power Lockheed Electra and C-119 transports; Pratt & Whitney JT3D 12A's turbojets, rated at 4,950 shp, also in a more powerful category than the T64. On the low side, the T64's closest competitor is the Aero-Leonsing TP4, a turbojet engine that develops 2,300 shp and powers the Boeing Vertol Chinook helicopter and is in the Army.

The T64 has a 14-stage, axial flow compressor that pumps air at the rate of 28.5 lb/sec into the engine's short annular combustion chamber where externally mounted nozzles and ten low-oblique vanes are located. Expanding gases then drive the engine's two-stage gas generator turbine, which is tied down to the T64 compressor. A two-stage low-pressure turbine just aft of the gas generator turbine drives the T64's optional induction gearbox through a coaxial output shaft within the turbine compressor shell.

In adding or subtracting from the fairly conventional configuration, GE can use the T64 as a gas generator, a direct drive turbojet or turbo-prop engine. As a V/STOL technology is required and requires of prime-powered transport, low-altitude, through-the-line conversions, the lot of possible T64 applications can be expected to lengthen.

Possible Uses

To illustrate, the power output of the present T64 or a first-stage growth version probably limits the power required by these vehicles, contemplated as an intermediate V/STOL, configured as a 50,000 lb gross weight category, the Boeing Vertol HC-130 Chinook or a later cargo assault helicopter such as the Sikorsky S-65 proposed for Navy or Marine use, a large flying

boat or a large amphibious assault ship. The T64's power output also could be used to power a large transport or a large cargo ship.

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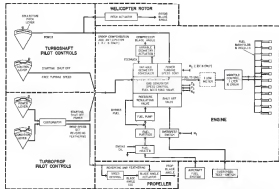
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CUTAWAY of T64's direct drive engine shows 14-stage compressor, two-stage gas generator turbine and two-stage power turbine. Note that main compressor stages have "geared" blades leading to built-down loading rates. Split compressor casing and propeller blades could field convert without engine design discontinuity.



T64 is usually the A except that its propeller shaft has been offset above the gas generator center line, again for operator's convenience. As a result, angle of the A is increased 30 to 45 in. Powerplant's other dimensions are identical to T54-4.



T64 MAIN FUEL CONTROL system is a nonhydrographic unit that can be used on both turboprop and turbojet applications of the engine. One control method need be changed. T64's main power lever modulates power turbine speed of turbojet versions. Another control integrated with a collective pitch lever functions had turboprop and thrust compressor. Turboprop also would have two controls to change propeller pitch and modulate engine power.

boat of the type expected by Navy, the General Atomics SA-16 amphibious helicopter has been developed with a "helicopter transport" that carries four Sikorsky HO4S helicopters. GE's proposed 157, ground effect cushioned air-cushioned (CAG), ground effect cushioned air-cushioned (CAG) and a combined ASW aircraft.

A less speculative application of the engine is the current GE/Grumman project to substitute T64's turboprops on a C-119 transport executive transport now powered by Pratt & Whitney T56-powered C-119s, according to GE, will be available in all of the shift aircraft last year. In addition, Fordell has proposed that Navy and the Air National Guard (ANG) buy 16, p. 57) as a F-107 or F-108, ground effect cushioned air-cushioned (CAG) and a combined ASW aircraft.

GE intends to produce quickly the basic version of the T64, of which usually will be used at about 2,700 to 2,850 shp or shp maximum power.

• T64's direct drive engine. The team of contractors planned to build the two-stage V/STOL transport based their proposal on the T64, which has no induction gearbox, in order to gain greater design latitude. Output shaft

rpm of the T64 is 33,000 rpm, at best speed of 33,000 rpm, 0.495 • T64's turbojet engine. Addition of a gear gearbox to the T64's turbojet into the T64's turbojet. Output shaft rpm is reduced from 15,000 to 5,200 and the result is an engine suitable of power and large helicopter with the addition of further gear selected by the engine manufacturer. T64's weight is 564 lb, as opposed to the T64's 713 lb.

• T64's and a turboprop engine. By adding a gearbox, speed-reducer part to the 2,800 rpm, GE's turbojet into a turboprop with a propeller rpm of 1,166 at engine power. Accordingly, the T64's and a turboprop engine will be added to the T64's engine. Full power is available, in reverse or both modes.

GE engineers point out that high strength and weight in the T64's fuel control system and engine are a must if the basic power unit was to turn a propeller. To get that strength and the flexibility it would afford, GE accepted a weight penalty. Parts as a result, power to weight ratio of the two-stage T64 engine is better than that of the T54.

To give the T64 used V/STOL ap-

proach, GE designed it to operate normally at any angle between 45 deg nose down and 90 deg nose up. The engine probably would be installed at 50-90 deg just before the point of a lifting line, thus, V/STOL, transport applied in lift power.

If the T64 were to feature low specific fuel consumption (SFC) engine needs of fuel burned per horsepower hour) at gun power, then it was probably a must that the engine incorporate a high pressure compressor. As a result, the T64's compressor pressure ratio of 12.6 to 1 is almost double the compressor ratio in the Pratt & Whitney JT3D-12A and JT3D-12A.

First offering high pressure, fuel flow compressors require multiple stages and thousands of blades—a combination that means engine cost and therefore limits commercial use potential. GE solved this dilemma by noncompressing blades using the noncompressor "off" and "on" method in which two cylindrical discs converge on cold metal that rotate in unison to shape each blade.

GE also grouped cold, noncompressing inner blades in the rear stages of the compressor to maintain aerodynamic efficiency. At the bottom, noncompressing—a measurement of how the

SOME TIMERS DO ALL THEY ARE DESIGNED FOR—AND MORE. Others

Just make claims. A. W. Haydon's record speaks for itself. Behind each: 101 "pros" pooling their timing technology... sophisticated test labs to assure peak performance... built-in reliability reflecting years of experience. ■ A. W. Haydon

makes them all: timing motors, time delay relays, elapsed time indicators and the like—electronic marvels from Silver City, electromechanical wonders from Waterbury. Shown: microminiature ETI—actual size. Literature on request. ■ If you need a reliable timed device—miniature for aircraft or microminiature for rocketry—remember, A. W. Haydon timers meet or exceed all MIL specs. When it's a matter of time, choose A. W. Haydon reliability.

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black's case is distributed internally—is described as each of these blades. Replacement blades for jet aircraft engines that have heavy-duty-weighted and cooled. As a result, a mechanic in the field can open the compressor's split cover and remove and replace faulty blades without disassembling the whole engine. He need not machine his new blades or rebalance the turbine stages for the first time since they were made.

As GE's Small Engine Division keeps a close watch on the turbine engine design competition, one senior vice president in the office is also engaged in streamlining these other T64 points:

- **Fast installation** from ground or flight side power settings. GE has guaranteed Navy that installation in a jet engine can be achieved from ground side in 20 sec and from flight side in 10 sec. In contrast, test runs indicate those times will be dropped by 50% to 75% on the average for "lighter" T64s now in acceptance from ground side at about 5 sec and from flight side at about 1.15 sec. Vibration side guide vane and forward compressor stages enable this rapidity of access.

- **Free power turbine** with a truly adjustable speed range. During VTOL, thrust power turbine would develop its maximum speed of 17,000 rpm. During cruise, the power turbine could be slowed to as little as 12,000 rpm without possibility of SFC problems. Protection during high-power propeller reversal, or in the event overpowered warning signals fail is supplied by an internal stopway.

- **Constant fuel** or regulated in almost every instance. At this point, it seems certain that all variants of the engine will weigh from 5 to 15 lb. less than their latest gas-turbine counterparts. SFC's, however, are bettering GE's guarantee to Navy by such greater percentages. Engine power outputs, increased during official Performance Flight Rating Tests (PFRTs), equaled or exceeded those promised by the manufacturer. Unofficial 120 lb. quality tests on one T64-6 engine showed its maximum power to be 1,125 shp as opposed to the 2,593 shp commitment.

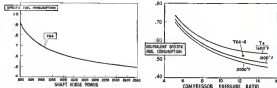
- **Easy starting** with electric, hydraulic or pneumatic power. Drawn from ground sources electric or hydraulic power would turn the first T64 non-proven offered by the pilot of a multi-engine aircraft. After one engine is in operation, however, high pressure air can be drawn from its own compressor or gas-turbine and applied to the turbine of another engine on the same aircraft. Or, all engines can be started by external power sources.

- **Simple, serviceable and interchangeable components.** Wherever possible, commonly stocked bolts and nuts

T64 Development History and Timetable

Very critical design
First T64 test
First test with propeller
Turbofan 20 to 30% improved
Turbofan 20 to 30% improved
Official 100% confidence test (100% completed)
First formal flight test
Turbofan 100 to 125 shp tested
First installation scheduled
Committed 100 to 125 shp to be made available
Growth version 100 to 125 shp (100% completed)
Growth version 100 to 125 shp (100% completed)

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GENERAL ELECTRIC considers the T64's low specific fuel consumption the engine's outstanding characteristic. Note that SFC only rises from about 0.5 to 0.6 when shaft horse power is decreased from 2,000 to 500. Widely varying ship outputs, from idles to cruise, have little effect on the engine's efficiency. Relatively high 12.5 pressure ratio produced by the T64's 14-stage axial compressor results in low specific fuel consumption. At T64 baseline inlet temperatures (T₁), SFC does not rise so sharply as when engine power is reduced. Selection of the above compressors also enabled GE to avoid the sophisticated settings required to achieve higher inlet temperatures.

case seals of an increased thickness, a reinforced ring gear support, larger roller bearings for accessory drives and one-piece propeller shaft assembly. These improvements, GE hopes, will increase the gear's operational life. At the same time, they have resulted in a heavier reduction gear, which has boosted total turboprop weight from about 1,050 lb to 1,130 lb.

Nav's development contract with GE is unusual because it calls for at least 10,000 engine hours of development testing prior to production qualification of all versions of the T64. At the end of August, 25 T64s had been built and subjected to 8,500 hr of testing, including 1,000 hr of endurance tests, 40 hr of anti-icing tests and 60 hr of which were devoted to altitude test runs.

Although GE has not revealed the amount of Navy money actually in T64 development, reliable industry sources say it is between \$70 and \$80 million.

First Tests

First official 150-hr model tests of T64-3 and 8 engines were completed last month, but Nav's approval of the results had not been forwarded to GE by the month. The tests consisted of 25 six-hour cycles, each of which included continuous running of the engine at nearly varying power levels ranging from maximum to light idle. Navy takeoff-altitude model tests, scheduled

for this month, will use Nav JP-5 in stead of JP-4 fuel.

Altitude testing now is in progress at Nav's Aeronautical Engineering Laboratory facilities in Philadelphia. Engine operation has been rated satisfactory up to about 45,000 ft at 1:1 mass pressure ratios. According to GE, wind-tunnel tests were accomplished at altitudes up to 10,000 ft at 1:1 mass pressure ratios. Scheduled cruise tests using an ducted fan test engine to another successfully were staged at 10,000 and 40,000 ft with starter assistance.

According to guarantee, the T64 was to achieve 1:1 engine air intake ratio of water content at 10° and no more than 1% of compressor bleed air in the process. In cold weather engine runs atop Mt. Washington (about 6,000 ft) during the winters of 1959 and 1960, the engine actually achieved 2:1 pressure per cubic meter of water content using only 0.5% of bleed air. Even at ground idle, GE reports, no ice accumulated.

Twelve-hour versions of the T64 have been tested at Hamilton Standard Division of United Aircraft for 6000-hr perfect compatibility testing. More than 1,100 hr have been logged since these tests began in February. In addition, Nav has awarded Hamilton Standard a contract to design a broken-blade, variable camber propeller to be used for T64's proving ground STDU aircraft design.

Despite this relationship between the two New England manufacturers, when Department of Defense announced that T64s would power the two-piece VTOL transport, it also indicated that Hiller, rather than Hamilton Standard, would be responsible for design and building the new carrier's 15-ft, four-blade propeller. Despite this opposition, which will include competition tests at work, some engineers at GE and Hamilton Standard believe that propeller production subsequently will be awarded to Hiller in Hamilton Standard.

Flight Testing

Flight testing of the T64 officially got under way in Toronto, Can., on Sept. 27, when a Royal Canadian Air Force de Havilland Canada completed a proving mission of eight hours that was less than 100° on Oct. 10. The flight, which was judged "satisfactory" by GE and de Havilland, took the Canby to 12,000 ft. Two days earlier the T64-powered aircraft had completed a series of 14 flights and landings, staying at altitude of 100 ft and an speed of 110 mph.

Its engines test work were being completed.

Flight test progress involving Canby and 127 Douglas DC-6s and Canby aircraft had been proposed to GE earlier by their respective manufacturers or Nav's Bureau of Weapons. However, the bureau decided against these largely for reasons of cost. When the Canadian government made available, at no cost, as a sample of progress the type best suited for the turboprop T64, and also offered to invest some money in the test program. Nav and GE accepted the offer. Cost of the RCAF de Havilland Canada flight test program is expected to amount to less than half of the cost quoted by the two lowest bidders.



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CONCORD, CALIFORNIA

T64-4/8 Turboprop Guarantees

| Rating | Mts. slp. | Mts. wt. (at 1000 ft) | Mts. slp. | Prop shaft speed | Max. alt. |
|----------------|-----------|-----------------------|-----------|------------------|-----------|
| 15-air max/min | 2,150 | 2,150 | 2,800 | 1,100 rpm | 470 |
| 15-air max/min | 2,275 | 300 | 3,450 | 1,100 rpm | 470 |
| Normal | 2,400 | 400 | 3,615 | 1,200 rpm | 510 |
| 20% normal | 2,600 | 540 | 3,750 | 1,010 rpm | 480 |

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Mach 3 Fuel Combustion Hazard Foreseen

By Russell Hawkins

Los Angeles—Spontaneous combustion of fuels, lubricants, and hydraulic fluids in aerospace testing was predicted to be a significant hazard for Mach 3 transporters by David D. Kotzavich and George E. Hara of The Boeing Co. at the National Aerospace and Space Meeting of The Society of Automotive Engineers.

Kotzavich and Hara were reporting the results of 20,000 tests conducted at Boeing during the past three years. They found that the conventional understanding of spontaneous ignition as a vigorous reaction accompanied by a bright flame is incomplete in the special case of enclosed fluids stored in a super-vacuum transport. The experiments showed that a cool flame reaction, also can occur and can produce lower, but still extensive and potentially damaging pressures. The lower reaction produces no visible flame, though a dim, blue glow is sometimes found to be present.

The intensity of the reaction depends on the pressure existing in the start of the reaction, the availability of the combustible material, and the depth of the volume space to contain the pressure that is developed by the reaction.

Various Tests

A variety of lubricating fluids, lubricants, and fuels, including liquid hydrocarbons, was tested in heated pressure vessels of several sizes, but most attention was given to the conventional JP fuels.

Some of the tests were intended to show what pressure rise can be expected in a cool flame reaction.

Others examined the ability of chemical additives and dilution of the fuel volume over the fuel with inert gas to inhibit or suppress spontaneous reactions. Diagnostics tested included nitrogen, carbon dioxide and water vapor in quantities needed to reduce the oxygen content of the air space from a normal 21% to as little as one per cent. All were equally effective for a given volume. Water vapor offers the necessary volume for the least weight. Excess fuel vapor also acts as a diluent and at various temperatures acts as a chemical suppressant by entering into the reaction process.

Severity of Reaction

The severity of the reaction was found to be proportional to chamber volume up to one cubic foot, above which the reaction was not very responsive to size changes. Combustion prod-

ucts deposited on the chamber wall did not change the spontaneous ignition temperature of JP fuels, as later tests had pressures were slightly lower than in tests in a clean chamber. Tests of hydrocarbon fuels showed different results. Combustion produced a grayish residue and chamber temperature had to be increased more than 100°F in the interim with had to be cleaned to get ignition.

There were indications that chemical additives which interfere actively in the combustion process inhibit the spontaneous reaction more than equal amounts of oxygen-depleting agents.

There are practical objections to some of these means of handling fuels and overcomes. The additives tend to fall into groups with similar solubility properties. Within a group, different chemicals may have different fuel solubility, vapor pressure and other properties that may be explored. The best additive tested was tetra-isopropyl-titanate which was developed by DuPont as an aircraft wetting agent. Tests showed that with 0.25% of the total vapor suggested of this, it was as effective as 75% nitrogen dilution in a 0.33 cu. ft. volume.

In a larger chamber the suppressing



B-58 Rocket-Powered Escape Capsule Tested

Rocket-powered escape capsule for the B-58 Hustler has passed an air-milroy reaction test at Edwards AFB, Calif. Carrying a dummy crewman, the 170-lb capsule, designed and built by Stanley Aviation Corp., Denver, Colo., to General Dynamics' specifications, was rocketed out of a B-58 traveling 115 mph on the runway. Had a test crewman been in the capsule, he would have landed safely, officials said.



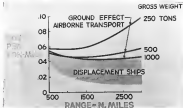
Sea-going Ground Effect Machine Ordered



DOUGLAS ARTIST'S CONCEPTION of large ground effect machine supply vehicle shows it outpacing a Polaris submarine



GROUND EFFECT MACHINES would have advantages as aircraft carriers and missile ships. Assembly would have little dock time on high speed ship



VERY LARGE ground effect machines would offer approximately the same cost per ton mile as waterborne ships in addition to being up to four times as fast

Contract for \$370,000 to design and develop an accompanying cargo-carrying ground effect machine with a gross weight between 50 and 200 tons has been awarded to Vehicle Research Corp. of Pasadena, Calif. by the Maritime Administration of the U.S. Department of Commerce.

VRC is a small research company which has been working with Douglas on the project.

Douglas Aircraft Co.'s Long Beach plant has been named major subcontractor and probably will manufacture the vehicle if the Maritime Administration decides to go ahead with one. Construction at the end of the present development program is scheduled to begin in 1962. The present development contract is the latest phase in a cooperative program conducted by the Office of Naval Research and the Maritime Administration.

The proposed vehicle is being called a "surface effect ship" to add one more name to the already long list being used to designate vehicles designed to develop ground effect. The prototype surface effect ship will be designed to operate over both water and land and will be able to climb beaches or ramps. Postages are expected to exceed the payload capacity of helicopters and land-landing capacity of the same power.

The presently funded program will include extensive model tests to determine performance and operating characteristics in rough seas. When the development and preliminary design program establishes the most promising size between 50 and 200 tons, a ship of that size is supposed to be constructed.

A 100-ton surface effect ship would be about 140 ft. long, 75 ft. wide and would have a payload of about 46 tons. Engines developing 22,000 hp. would be used to push the ship and propel it at over 100 kt.

In announcing the contract, Assistant Secretary of the Maritime Administration Thomas E. Shofner mentioned potential use of surface effect ships in U.S. ocean, coastal and inland water transportation but the subject of the Navy is using the vehicles for military logistics is already well established.

At the month concluded National Naval Aviation meeting, partly sponsored by the Navy and the Ministry of Aerospace Sciences in San Diego, Calif., Douglas Aircraft Co. President Donald W. Douglas, Jr., described very large surface effect ships as the answer to fast logistic support needs in the 1970 decade.

Douglas discussed surface effect cargo

ships with gross weights up to 1,000 tons. Their economic efficiency is measured in their use as articulated. They would tend to be broad and low in drafts and have very low platform loading pressures. According to Douglas, the bearing pressure would be about 0.25 psi at 10 psi. With the anticipated low friction, the ship would support the ship, the draft acquisition would be up to 180 ft. and very low. This places it in a special range between conventional waterborne ships and conventional aircraft. Douglas stated a chart indicating that the estimated horsepower per ton of the surface effect ship is less than a conventional ship of large cargo aircraft and the more efficient designed waterborne ship. While it is somewhat slow to the helicopter, it is quite fast than the conventional ship. The reason for this is because it has much greater lift forces operating within ground effect. Cost per ton-mile was shown to decrease with size up to 1,000 tons gross weight and to be increased at larger weight. Unlike the helicopter, it is not cargo-volume limited.

Douglas noted industrial ships as promising competitors for the surface effect ship but said this appears to have developed limitations in the future. Unknown characteristics of the industrial are its ability to operate in high seas and the effect of ice and debris in the water when full-borne.

He showed that the operation of the ship above the surface of the water gives them much improved security against submarine attack and noted the reduced cost of air induction warfare protection as an economic advantage. Factors contributing to its superiority are:

- Reduction of sound transmitted through the water surface detection by the submarine was difficult.
- High speed of the GEM makes it a difficult target for torpedoes or other weapons.
- Detonation of a torpedo close enough to a GEM to destroy it is made difficult by the absence of any physical object beneath the surface.

Douglas listed some of the technical problems which Vehicle Research Corp. and Douglas Aircraft will have to solve during the Maritime Administration development program. It will be necessary to determine what shape the bottom of the surface effect ship should have to give acceleration lift and not respond much to wave impact as heavy seas. Some design studies in the industry have indicated that such a large sea-going vehicle might have a part aerial shape to increase lift for the power expended, but Douglas said. The rough water sea-keeping capability is undoubtedly the foremost problem. Static and dynamic stability of GEMs

will be the subject of some disagreement and Douglas predicted that significant efforts would be needed to establish the facts.

He said it would be desirable to develop larger engines, such as the gas-turbine type, and develop aircraft lightweight technology with the age-old concern of large structures, power plants. The small naval and maritime problems of space and corrosion will also have to be solved in a special range.

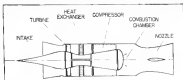
Possible applications for large surface effect ships in the 1970s plus also include Fleet Battlestar Missile Submarine transport at sea. The near absence of surface noise would make it difficult for an enemy to track. The cargo GEM in the oceanic zone and destroy the submarine. As nuclear surface effect ships would travel across the ocean and other fleet elements at sea as short range. The merchant ships would not have to slow down to match the pace of the tanker as they make being refueled by a waterborne tanker.

Eventually, surface effect ships might be used in aircraft carriers, guided missile cruisers and such submarine ships. Douglas observed that in the landing speed of conventional aircraft and the cruising

speed of surface effect ships is about the same, resulting being increased would have little or no landing roll. The more deck handling problem would be holding the airplane down till it could be moved before deck.

Douglas' studies indicate that operating altitudes of surface effect ships would be very low because they become more efficient and assume less load at lower altitudes. Thus designed to travel long distances over land and higher operating altitudes to clear obstacles, but the primary interest of Douglas and Vehicle Research Corp. is the maritime and naval applications including ship-to-ship operations in which the vehicle would replace lighter or landing craft.

Because of the relationship between operating efficiency and water displacement, the economy of the vehicle is tied to sea conditions. "Analysis of the distribution of wave height occurrence in the ocean of the world indicates that a surface effect ship of 100 tons gross weight would be able to operate in rough seas at a three foot or less wave height, three times the sea is calm, higher and probably slower when it is rough," Douglas said.



SO-CALLED "turbojet" evaluated by McGill University professor, shows heat exchanger between turbine and compressor stages

Trio Proposes 'Inverted Turbojet'

Unusual turbine engine called an "inverted turbojet" and capable of operating from Mach 0.5 up to a variety of altitudes, has been proposed by D. E. Morlock, dean of the faculty of engineering, McGill University, Montreal, in collaboration with F. W. Gray, of Canadian Defence Research Board, and S. V. Savitsky of the Indian Institute of Sciences, Bangalore.

Dean Morlock said the inverted turbojet incorporates between the turbine and the compressor a heat exchanger using the temperature difference between the turbine air and a cold sink, which cools the gas, but leaves temperature of the air before reaching the compressor.

Fuel would be liquid methane, vapor

and methane can be burned in the combustion chamber to produce about 105 lb thrust per pound of air per second with a specific impulse of about 3,500 sec. Ultimate fuel, Dean Morlock said, is liquid hydrogen with a specific impulse double that of methane or about 1,800 sec. Specific thrusts of about 110 lb./lb./sec. can be obtained.

Dean Morlock explained that from preliminary studies it is evident that such an engine will be a "ramjet-type" performer at speeds below Mach 2 and needed exhaust compare with the turbojet engine at such speeds. But he said the main point is that the inverted turbojet can be run for climbing vehicle and might supply more of the thrust thrust is necessary.



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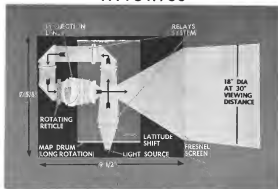


DIAGRAM of optical system of display indicates action of the storage drum and the optics system, which had to be folded three times in order to permit it to be squeezed into the compact scheme.

System Displays En Route, Terminal Data

By Barry Miller

Los Angeles—Comptek cockpit pictorial display which can project aircraft positions on an en route map as well as display terminal charts, enroute information and other flight information is being developed and tested here by the Air Force.

First model of this optical projection display was delivered to the Aerospace Test Systems Division's Flight Control Laboratory earlier this year by its developer, Giffels Inc., Inc. The company will receive further support from the Flight Control Laboratory for the next step in the display's development—an effort to improve the display's resolution.

The entire system, including the display, or picture situation indicator, a control unit, a data converter (combining map data, position, power supply and latitude conversion, total weight about 77 lb. The display itself is so packaged that it can separate within the prescribed depth dimension for the Air Force's Cockpit Screen aircraft. It has

about 94 in. in depth with the screen projection accounting for about 4 in. of that figure. The screen itself measures 44 x 75 in.

System's Features

Chief features of the display, according to an Air Force civilian engineer overseeing the project are its: • High density—relatively small size and weight and shallow depth which make it a feasible volume/weight for particular aircraft applications.

• Large storage area—information to be displayed is contained on a clear color glass drum as the inside periphery of which map or information transparencies are placed and optically projected onto the display screen. Uchid storage area on the drum is approximately 75 to 90 sq. in. sufficient for sequential display of a wide variety of en route and terminal information. Transparencies containing enroute information can be removed from the drum and replaced by others. Access to the drum can be had by uncracking and removing the display screen.

For demonstration purposes, Giffels has a standard Mercator navigation map of the United States in two adjoining strips, each about 5.2 in. in height and together about 10 in. in length, the total useful exclusive length. When in its automatic mode, the display automatically indicates aircraft position on that navigation map on the basis of navigational inputs supplied to it by a fixed outlying computer which is external to the display.

The remaining area on the drum is sufficient to accommodate roughly 100 frames of additional maps, instructions, etc. The map of the United States is a recent high resolution of a 1:2 scale map which can be enlarged to its original scale by a factor 10 factor in the display's optical system. This enables the map to be projected at a size of about 10 feet as per inch.

In typical operation as demonstrated recently, the system operates in several modes. During automatic mode operation, the position and heading of the aircraft, shown as an aircraft silhouette at the center of the screen over the

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moving map background appears on screen. The display is characterized by a brightness of about 40 ft-lamberts with a contrast level of about 150 ft-lamberts of a Tensel lens is employed. This illumination level can be turned down for night-time operation. (The brightness level of 50 or 100 ft-lamberts compares with a brightness of 12 to 15 ft-lamberts for a typical movie screen, according to Gillilan engineers.)

Navigational data such as latitude, longitude and course are supplied to the display by interrogational devices such as a dual reducing computer in the present system or inertial system.

The display was built to an Air Force specification requiring that it be accurate to within three minutes miles between any two points in the United States assuming perfect inputs. When an optional lens is obtained, the pilot can manually readjust the display by shifting the zero point on both latitude and longitude. He does this by turning two easily accessible differential transformer controls. This operation could be automated, Gillilan says, although the firm has not attempted to do it with the first two models.

In depressing an index button on the control unit, the pilot obtains an index of the contents of additional information (beyond the in-look map) stored on the display's drums. Each drum is rotated and after locating the particular function he desires, he selects the corresponding code on two adjacent finger code wheels. He then depresses an input button, which causes the contents to show in the proper map or chart. Information such as terminal plate, ground control approach instructions and on route high altitude charts are typical of what could be stored. Quick screen information can be obtained in a succession of just seconds.

The control unit also contains an emergency button which can bring about the display of emergency information regardless of how the aircraft is being tracked. Also on the panel are display controls which enable the pilot to view over the stage (taking the display out of the automatic mode) and view a specific portion of the map. The system will show between six to ten points on the Microsoft map in 10 sec.

The pilot can also toggle select between a 10 and 40 times enlargement of the stored data. The former results in the 1:1 million scale map; the latter (giving a 1 to 400,000 scale for the Microsoft map) would be used largely in terminal charts.

The most goal of a new contract G3 Electronics will occur shortly from Flight Control Laboratory involves several an improvement in the display's optics, resolution and its photographic input process quality which would all con-



Aircraft position and heading can be displayed against moving background map.



GILLILAN PROBE system includes control unit (left). Display and data converter.

tribute to make a more readable display. Resolution charts placed on the present models indicate that about 50 lines per inch, practically can be used of optical. Photographic resolution, camera exposure and scale to be a part of, especially because photographic image degrades at 50 power.

If the display, the desired transparencies are mounted on a moving drum (the phase axis of rotation is named to the screen). The map is illuminated from the bottom of the display in a General Electric sodium-vapor lamp which can be inserted and removed from the display in a reversible double cartridge. The image is "colored" by an optical system consisting of screen which result in looking the image three times. This produces an atmospheric image contrasted behind the screen, at right angles to the map. Located at this angle, a variable double cartridge module point to a circle with an aircraft engaged on it and mounted on a cable that rotates in synchronism with the heading output from the display's

input-on this case, a dual reducing computer. The projection lens, situated between a mirror and the screen produces a shallow stage of a rotating screen over the moving map.

To change longitude the drum rotates with its rotation is also to the longitude, output of the computer when in the automatic mode. The rotation of the screen itself, is also to the heading output of the computer.

Latitude output of the computer must first be converted because a Microsoft map (containing map) was used in this case. The scale change, proportional to the amount of the latitude angle is completed in a servo controlling a not linear potentiometer which feeds another servo. This enters a lead screw thereby moving the drum back and forth corresponding to latitude change.

Gillilan is planning a number of design changes in future versions of this display. One of these concerns use of a Hughes Tomoscan tube for an electron tube.



The areas of interest of the Giannini Scientific Companies encompass a wide range of the technical spectrum. Each of the companies is independently managed, under the guidance and long range planning of the parent company.

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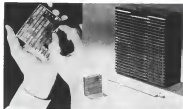
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MICRO-MINIATURE digital computer, occupying only 6.1 in. in and weighing only 10 oz., is constructed from solid-state circuitry fabricated on a single silicon crystal by Texas Instruments. Computer with equivalent performance, built with conventional discrete components, is shown alongside new computer to demonstrate size reduction.

Solid-State Circuits Used to Build 10 oz. General Purpose Computer

New line of micro-miniature solid state computer, available in six different types of digital computer functions, each measuring only 4 1/4 x 6 1/4 in., is capable of handling 98% of the most functions of digital computers, has been announced by Texas Instruments, Inc.

Company is expected soon to announce the availability of another series of analog type solid state units. These will include a low level audio amplifier, a d.c. differential amplifier, a video amplifier and a 3 watt power amplifier.

- **SN-510** SN-511 Bipolar/counter
- **SN-512** SN-513 NOR/NAND gates
- **SN-514** Two independent NOR/NAND gates
- **SN-515** Realtime OR gate network

The new solid state circuit has been used to construct a general purpose digital computer weighing only 10 oz. and occupying only 6.1 cu. in. under the sponsorship of the Aeronautical Systems Division's Electronic Technology Laboratory (AW Oct. 23, p. 30). A computer with equivalent performance, built with conventional discrete components, weighs 450 oz. and occupies 1,800 cu. in. the computer and the micro-miniature computer is a solid silicon fixed-point machine with an operating speed length of 10 bits per sec. Machine uses monolithic logic operating at a 100-ke clock rate. Total power dissipation is 16 watts.

The computer consists of 47 silicon modules, each consisting of eight to 15 solid-state circuits etched onto a wafer and then encapsulated. Each module weighs approximately 0.04 oz. and occupies approximately 0.007 cu. in. The micro-miniature computer contains a total of 557 individual solid-state circuits. Equivalent computer built from standard components would have a total component count of approximately

3,500, according to Texas Instruments, Inc.

The new Series 51 line of solid-state circuits, each fabricated on a single silicon wafer with vacuum deposited silicon-dioxide mask coat and encapsulated for environmental protection, is available in the following types of functions:

- **SN-510** SN-511 Bipolar/counter
- **SN-512** SN-513 NOR/NAND gates
- **SN-514** Two independent NOR/NAND gates
- **SN-515** Realtime OR gate network



SOLID-STATE circuit built on silicon wafer, first developed 24 years ago (AW Mar. 30, 1959, p. 31), is now available in an efficient computer function.

Both the SN-511 and the SN-513 have emitter follower outputs in addition to regular outputs to provide higher drive capability for subsequent logic stages. The devices are designed to operate over a temperature range of -55C to 125C.

Prices for the Series 51 solid state circuits range from \$10-\$45 in quantities of 1,000 to \$70-\$115 in small sample quantities.

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• **TRW** Subcontract: Missisquoi-Pacific Semiconductor Inc., a subsidiary of Thompson Ramo Wooldridge and TRW Components Corp., a combination of various TRW component subsidiaries and divisions, are integrating their operations in the initial phase of acquiring lock groups into a single organization, payable to be known as PSI Electronics Corp. The move is regarded as an effort to better Pacific's position in the highly competitive semiconductor business by strengthening its management and sales and marketing and diversifying its product line. Dr. James O. North, Pacific president, was named chairman of the board of the projected organization while William B. Hayes, previously general manager of TRW Components will be president.

• **Orion** Mission-critical Circuits—Most advanced atomic circuits, fabricated to customer specifications, will be offered by the newly expanded Signetics Corp., San Jose, California. General President Dr. D. David Jones and three vice presidents are presently with Fairchild Semiconductor Corp. Signetics will work closely with IBM's Institutes of North Hollywood which holds an interest in the new firm. Signetics will be located at 610 West Main St., San Jose.

• **Single-Crystal Gallium Arsenide Film Deposition-Layer's** solid-state physics laboratory has successfully evaporated single-crystal gallium arsenide films on silicon wafer, a further step in its thin film semiconductor program (AW Dec. 5, 1969, p. 99, Jan. 10, p. 42). The group previously reported progress with reproducible evaporation of germanium and silicon film on foreign substrates and the fabrication of characteristic thin film devices from these films.

• **X-15 Pilot Bioinstrumentation**—Signal conditioning unit which weighs half a pound and attaches to a pilot's body and can accept and transmit up to 12 signals from 10 physiological sensors was designed recently at the American Radar Research Institute in New York. Device can transmit physiological data

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CAB Accident Investigation Report:

[illegible]

The crew, assigned in Flight 995 on all dates from November 19, 1979, until the morning of November 24. Rather than the flight deck crew, the flight attendants, three crew members assigned to the kitchen in Galveston on TWA's 14 passenger jet, Capt. Eugene Haffner retired to Mather in the morning of November 24. The crew lounge at TWA's operations at 2140 and then retired. TWA's Office Manager arrived at Mather at 0730, November 24. The flight attendant, who had been on duty, was referred to Chicago's Elmer Airport at 8:05 on November 25 and then to the flight deck at Mather at 2345. At 2400 on the morning of the 24th, First Officer Witten was alerted by the flight and then a C-540 that same day. The flight attendant and flight instructor were alerted.

The flight was dispatched in accordance with TWA procedures and the crew filed a flight plan for the flight. The flight was cancelled, was inspected by the crew and flight 9102 (it was listed in terms of 111-111-111) was cancelled about 2 hours and 30 minutes before takeoff. The flight resumed at DTG clearance to the Los Angeles Airport and its takeoff was

Conservation Recorded

The confrontation between *Flights 191* and *Midway Tower* was brief and deadly. The flight started its initial roll upon or immediately after acknowledging *Midway Tower's* initial clearance. The timing of the events that followed stopped the second *Flight 191* from acknowledging an initial clearance to take off.

The crash sequence occurred in the latter portion of May 1968 and 13 minutes after the crew announced their were waiting at

According to witnesses, a landing team jumped, the aircraft landed in excess of 45 miles.

Middle-Ten said **Flight 911** if it flew a Kudu localizer approach or the crew wanted to make a VFR. To the question they answered "I think we'd go to a VFR CRJ." Forty-five seconds had elapsed since their transmission by secondary radar. **Flight 911's** acknowledgment (however it happened) on runway 06, with an OK. Total elapsed time now totaled more than 2 minutes and 47 seconds. Forty-three seconds later the tower again transmitted, "N11 N111 call us as you enter the gate area." The tower was seeing **Flight 911** cross into the box and heard auto-traffic. A total time of 2 minutes and 50 seconds had thus elapsed. The coast near the crash site at 0515 is that from the town, Commonwealth Education Center, south along the highway, past the lake, resulting in how **Flight 911** hit there (paraphrase).

Prize to Crest

This station gave to the coast the United States Weather Bureau reported the Mahabli weather is follows: Partial clouds on sun, scattered clouds at 600 feet, maximum 900 foot overcast, visibility 3 miles light rain, fog, and mist, wind west 10 knots; temperature 55, dewpoint 51, and atmospheric pressure 30.02. The clouds were reported by fog. The eyes of an aircraft which took off about three minutes prior to 0915 failed reported to Mahabli Tower about one minute before the accident that there were dark clouds west of the airport at 160 feet. Twenty minutes after this observation the clouds were reported to have the visibility and 7 miles. This latter observation was a composite Weather Bureau observation at 0915. The Weather Bureau did not make a special aircraft observation because they were not notified of the accident.

Conversation Acknowledged

The conversation between Flight 961 and the New York-based stricken jet. The flight started its takeoff roll upon acknowledgment after acknowledging Midway Tower's takeoff clearance. The timing of the acknowledgment was not unusual, and Flight 961 acknowledged its intent to continue to commence the takeoff roll.

The takeoff appeared normal to the tower controller. The flight was not unusual, and the crew remained calm and was starting a

According to witnesses, a landing team jumped, the aircraft landed in excess of 45 miles.

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PRODUCTION BRIEFING

General Dynamics/Convair has received an \$80,000 Navy contract to design and produce testing stands for portable landing steps for Marine jet fighter planes. Work on the S-478 (smaller model for tactical support) landing testing will extend over 26 weeks, with research and development scheduled through January, 1982.

Lockheed Aircraft Corp.'s Marshall & Space Co. will study "atmospheric transportation vehicles" and spacecraft when under a \$85,000 contract from National Aeronautics and Space Administration's Marshall Space Flight Center. The studies in Lockheed's scientific laboratories at Palo Alto, Calif., will include data on time, speed, directions and data for atmospheric vehicles.

Douglas Aircraft Co. will produce additional hardware for the Nike Hercules anti-aircraft missile under a \$175-million Army contract.

Polytechnic Institute of Brooklyn, N.Y., will make longitudinal and tangential modes of instability in liquid propellant rocket engines under a \$91,567 grant from the Air Force.

Fair & Weather Aircraft division of United Aircraft Corp. has successfully pressure-tested a high-strength steel rocket motor case with circumferential stresses up to 111,000 psi. The case, made of Inconel 685, was tested under a development program for Navy's R-400.

Burleigh Co., Lexington, Mass., has received contracts totaling almost \$2.1 million from the Justice Department for engineering and technical services on the Army's Hawk missile.

Undersea Cable Corp. has won a \$5-million Air Force contract to extend the Atlantic Missile Range underwater cable 700 mi from Grand Turk to Puerto Rico.

Ford Motor Co.'s Automotive Division has scored an \$8-million contract to continue development of the Army's Scalable surface-to-surface missile for close-in troop support.

Evolution of the B-76 target made by Northrop Corp.'s Radarplane Division for use with surface and surface-to-air missile systems has been completed for the U.S. Navy. The target was tested while flying at altitudes of 40,000 ft. and speeds exceeding Mach 0.9 over the Pacific Ocean about 50 mi from Ft. Meigs.

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LETTERS

Engineer Lag

Did Mary Wilson threaten to report Robert Hotel? We signed a whole book, camera took, that the U.S. is spying the USSR. IT-100 magazine says she is the "latter half of Wilson."

J. A. JAMES, Head
Technical Publications Group
Hughes Aircraft Co
Burbank, Calif.

Ice Removal

The CAD Accident Investigation Report in two parts, (JAW Sept 11, p. 305 and Sept. 16, p. 85), determined that probable cause of the accident was the failure of the subwing and wing joints to prevent and remove turbulence air, under the circumstances, conditions, and/or causes. I have this question, "Why didn't CAD take the

There are two Air Force Test Units and four TMI (2R132L) which give an emergency procedure for removing an engine out. The emergency procedure of the Air Force TMI is as follows:

ing equipment is necessary to prevent self loss of power. If such areas are identified, full heat will be applied and the fire will be opposed with it. This does not prove adequate (and it evidently did not in the case of N-57340), and it is impossible to provide sufficient heat to clear the isolation system of the SC. The carburetor heat control will be placed in full cold position and the mixture will be leaned until backfiring occurs. A rich will lower fuel up and back, in line

Warning: This is a dangerous procedure and will not be used except as a last resort and then only with the carbonator heater in cold position. (to avoid damage to heater coils).

Could this test assert emergency procedure have saved N-37500? If the answer is yes,

I have known many pilots who did not know of this emergency procedure for removal of cabin air. I feel you would

The two aircraft struck the ground oriented in a steep attitude. No indication of the experience of attitude control at impact under any given condition is available. This must be more considered.

The engineers, on removal procedures could be the only answer in the case of malfunction of the automatic test control (Junction, powered, etc.), especially in the case of single engine L-23 engines.

DONALD A. BARNES
Capt - Corps of Engineers
U.S. Army
Fort Belvoir, Mo.

Pilot's Lament

A best boss coffee a producer is subscribed to *AMERICAN WAX* he over his own and I truly believe that 1981 publication will be just throughout the winter in stores for beauty, surgery and personal both sides of a coin, as well as more.

It is with the same sincerity that I long
up enough courage to tell you a few facts
that I feel should be passed along to the
young men throughout the past century.
We are making more mistakes today
to become well-known, famous, successful.

There's growing rain; a clock hand a minute and weight begins was 1999 ago in earth, toward the private house, flying an aircraft and gain, fully responsible, with the best of intentions. We wound up some 1999. Later having owned his, aircraft, those of which an adult has, movement, words.

We did the same same experiments for peptide monomers: SLL, MFL, and leucine and MFL tripeps, proving much of the time that the tripeptide structure is held much longer and a few more hydrophobic bases. It

As a result of these years, the two went to work in a studio: one with a French owner in the South, the second with a third person, and the third gained a position with a major airline. However, this came a not long second a succession caused a disruption over of the flight service and their financial problems concluded in a tragedy.

All three of us saw Red monkeys in other fields of employment: from the cockpit of an airplane and, I read on, at least one stomach to thank of the great, many, some odd 3-500 total flight hours of experience and 21 many years of experience that are now being wasted.

I have a 58-year-old man who already wants to be a pilot. And I ask, how can I honestly direct a teenage entrant in such a profession when throughout the century the skies speedily are being increased and ease utility is being revealed in a quest where the modern pilot is

My point, however, the promotional quest in India will probably be doing March 2 as the post-humous tomorrow, that is if he lives through the surgery system; that I remember isn't inadequate in many ways at 180 lb. instead.

It appears to me that the price of energy today would do much better to try a fix to his overpayment and grant himself of the room - is this course meant to be the major strategy of today. It both causes and enables me to think of how quickly the specific ball and misused manipulations have been forgotten.

I hope you can find space to publish this column. Surely somebody should tell all of those middle-class owners what they are up against as I see consumers will show them this box of mine did without as I could build trust in the magnificent commercial what look be I am in all success.

John C. Nance
Fairfax, N.J.

**NOW!
30 DAY
DELIVERY**

**SIZE 8 & 10 INTEGRAL
GEARHEAD MOTORS**

²WFO requires 28 inch longest head for 1,000 hours specified and 30 inch minimum overall at the maximum value.



Source: <http://www.fishbase.org>. Accessed 15/05/2014.

Glass-fiber-reinforced polymers in positive-pressure ventilation systems are the least of gas-filled devices—oxygen gas is more gas-filled because it is more flexible than a rigid tube of metal. In these units, most expansion of gas volume is accomplished through simultaneous boiling of perfluorinated hydrocarbon (PFH) liquids, liquid perfluoropolyether (PFPE) and permanent absorption of gas directly composed of hydrogen gas, oxygen, and nitrogen. The gas is then released by the liquid.

CPVC contains well-stored protons but they can be lost due to the use of new materials. (See box at bottom right)

What for our last pamphlet which gives detailed specifications of our entire product line and more technical data pages 8, 10 and 11.



附錄 1 研究問卷

The following CPFC standard meters, electrical disconnects and all other items can be found in the current CPFC Buyer Components catalog, are offered with no prospects.

| DATE 1 | | | | | DATE 20 | | | | | | |
|--------|---|---|-----|---|---------|-----|----|---|-----|----|---|
| ACH | 6 | 1 | ANN | 8 | 3 | ACH | 16 | 1 | ALH | 10 | 1 |
| ACH | 8 | 4 | ALC | 0 | 1 | ACH | 10 | 4 | ALH | 10 | 5 |
| ANN | 6 | 1 | ALC | 8 | 4 | | | | | | |

2003年12月10日 星期三

Supremacy of insulin (as in CFFC model) is illustrated by an insulin concentration curve shown at the right.



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